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AMELOBLASTOMA OF THE MANDIBLE WITH METASTASIS TO THE LUNGS: REPORT OF A CASE

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IT has been observed for many years that recurrence of ameloblastomas frequently follows local excision, but metastasis is extremely rare. A careful review of the literature discloses ten reports of metastasis from ameloblastomas. (Eve, Simmons cases II and VII, Horsley, Ohinouye, Heath, Weissenfels, Spring, Vorzimer and Perla and Phelps.) Ewing[1] mentions two instances of metastasis from this tumor, but apparently these cases were not reported under his name. We were unable to obtain the original publication of Abramson[2] entitled "Ameloblastoma with Metastasis to the Lungs." In an effort to evaluate these ten reported instances of metastasis from ameloblastomas, the authors' histologic descriptions, photomicrographs and illustrations were carefully studied. The ten reports are as follows:

Eve[3] reported an ameloblastoma of the mandible in a man aged 60 which metastasized to a lumbar lymph node. The drawing accompanying this report is consistent with the pathologic diagnosis of an ameloblastoma. Simmons[4] described an ameloblastoma in the mandible of a woman aged 22 which metastasized to a lymph node at the bifurcation of the carotid artery (Case II). He also described an ameloblastoma in the mandible of

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a man aged 25 which metastasized to the cervical lymph nodes, with "evidence of lung metastases." Although necropsies were not performed in either of these cases, the tumors described in the lymph nodes were undoubtedly ameloblastomas. Horsley[5] reported a tumor in the right jaw of a woman aged 22 which metastasized to the lungs. Sections from this tumor were examined by Kegel, Bloodgood and Broders, and, although there was no complete agreement as to its origin, the preponderance of opinion was that this tumor probably represented a carcinoma of low grade malignancy arising in the mucous membranes of the mouth. Ohinouye[6] reported a tumor in the mandible of a 15-year-old boy which metastasized to the lungs. The author stated that the primary tumor was an ameloblastoma, but that the pulmonary lesion resembled carcinoma. Neither a histologic description nor any type of illustration accompanied this publication. Heath[7] described a tumor of the mandible in a man which metastasized to the opposite jaw, right deltoid region and pelvis. According to Heath's own description, the stroma of this tumor was that of a round-cell sarcoma which enclosed masses of epithelial cells. Such a description is not consistent with the pathologic diagnosis of an ameloblastoma (no necropsy). Weissenfels[8] reported an ameloblastoma in a man aged 26 which metastasized to the soft tissues at the angle of the jaw and to the cervical lymph nodes. There was roentgenologic evidence of metastasis to the lungs. Although no necropsy was performed, the histologic description of the metastatic tumor in the cervical lymph nodes was that of an ameloblastoma. Spring[9] reported an ameloblastoma in the mandible of a 5-year-old boy which metastasized to the frontal, parietal, zygomatic and sphenoid bones. The photomicrographs of the metastatic tumor which accompanied this report were consistent with the pathologic diagnosis of an ameloblastoma. Vorzimer and Perla[10] described an ameloblastoma in the maxilla of a 17-year-old boy which metastasized to the right lung and pleura. At the time of necropsy, it was observed that "the whole bronchial tree (on the right side), wherever it was intact was plugged with a cast composed of fairly firm somewhat friable, grayish-white tumor tissue." The histologic description and photomicrographs of the metastatic tumor leave no doubt as to the accuracy of the pathologic diagnosis of an ameloblastoma. These authors believe that the metastasis in this instance was aerogenous, and the following observations were submitted to support this conclusion: Aspiration was possibly due to the numerous operations and accompanying anesthesia. The lower lobe of the right lung is the favorite site for foreign bodies. The tumor was within the bronchial tree, with subsequent distention bronchiectasis, and there was no evidence of lymphatic or hematogenous spread. Phelps[11] described a tumor in the maxilla of a man aged 42 which metastasized to the liver and ribs. Tumor cells were also observed within the pulmonary vessels. We were provided with a section of liver from this case by Dr. E. T. Bell. It is our impression that the tumor in the liver represents an undifferentiated carcinoma rather than an ameloblastoma. This tumor

may have started as an ameloblastoma in the maxilla, but later became a carcinoma by prosoplasia.

To recapitulate: The reports of Eve, Simmons, Weissenfels, Spring and Vorzimer and Perla are acceptable as descriptive of ameloblastoma with metastasis. However, only in the case described by Vorzimer and Perla was there histologic proof of pulmonary metastasis. It is the purpose of this paper to report the second histologically proved case in which an ameloblastoma metastasized to the lungs and pleura. This case is of special significance in that it provides additional evidence that there is no apparent correlation between the histologic pattern of the ameloblastoma and its ability to metastasize.

REPORT OF CASE*

History.—O. N., a colored woman, aged 23, married, entered Barnes Hospital May 23, 1928, complaining of a pain and swelling of the left lower jaw and a tender lump in front of the left ear, all of two weeks' duration. Five years earlier, a left lower third molar tooth had been extracted. Eleven months before admission, the patient had a large abscess of the left lower jaw, which spontaneously ruptured into the mouth. The family history was not relevant.

Examination.—The positive physical findings on admission were pain, tenderness and swelling of the left side of the face. A left preauricular lymph node was palpable and tender. Oral hygiene was satisfactory. Routine laboratory findings on the blood and urine were not remarkable, but roentgenograms of the left mandible revealed a destructive lesion involving the body and ramus of the left mandible up to the level of the first lower molar tooth.

Operation.—The left half of the mandible posteriorly from the first molar tooth was resected. The coronoid process was not removed.

Pathology.—A section of the tissue removed at operation (Fig. 1, A) showed both solid and cystic tumor, the former predominating. Tall columnar cells lined the cystic spaces, whereas the cells immediately subjacent were polygonal. Beneath the latter, a stellate type of reticulum was observed. In some areas, tumor cells were present in the perivascular spaces. In other regions, hemorrhage and necrosis were the outstanding features.

Diagnosis.—The diagnosis was ameloblastoma of the left mandible.

Course.—The patient visited the Washington University Clinics at least once a year and remained free of symptoms until March 1935, when pain was again experienced in the left lower jaw. However, medical advice was not sought until the pain became unbearable. The patient entered the Barnes Hospital November 8, 1935, and an osteotomy was performed on the left mandible. A large cavity containing colloid-like material was exposed in the region of the ramus of the left mandible and evacuated. This cavity extended behind the maxillary sinus. The patient received 93 mg. of radium for twenty-four hours (2,232 mg. hours). A diagnosis of recurrent ameloblastoma was made from the tissue removed at operation (Fig. 1, B).

During the following twenty months, the patient entered the Barnes Hos-

*Representative tissue and slides from this case are on file in the Army Medical Museum (Accession No. 95817).

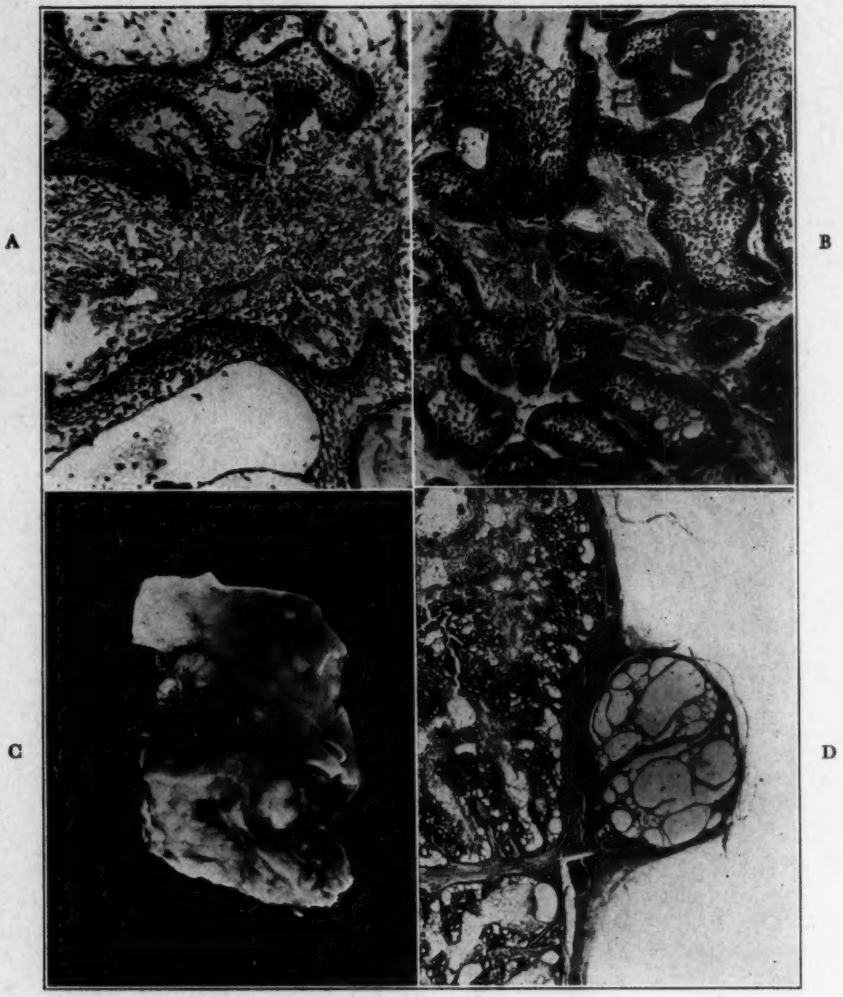

Fig. 1.—A: Original tumor. (×110.) B: Recurrent tumor. (×110.) C: Nodules at base of skull. (Actual size.) D: Nodule in subdural space. (×14.)

pital on six occasions for treatment of the tumor and its complications. December 14, 1937, she was admitted to the Barnes Hospital complaining of three nodules situated above the lateral aspects of the left eyebrow and on the left supra-orbital ridge, all of three months' duration. Roentgenologic examination of the skull at this time revealed a "destructive process of the skull, osteolytic tumor of the skull and questionable metastatic tumor of the skull." An

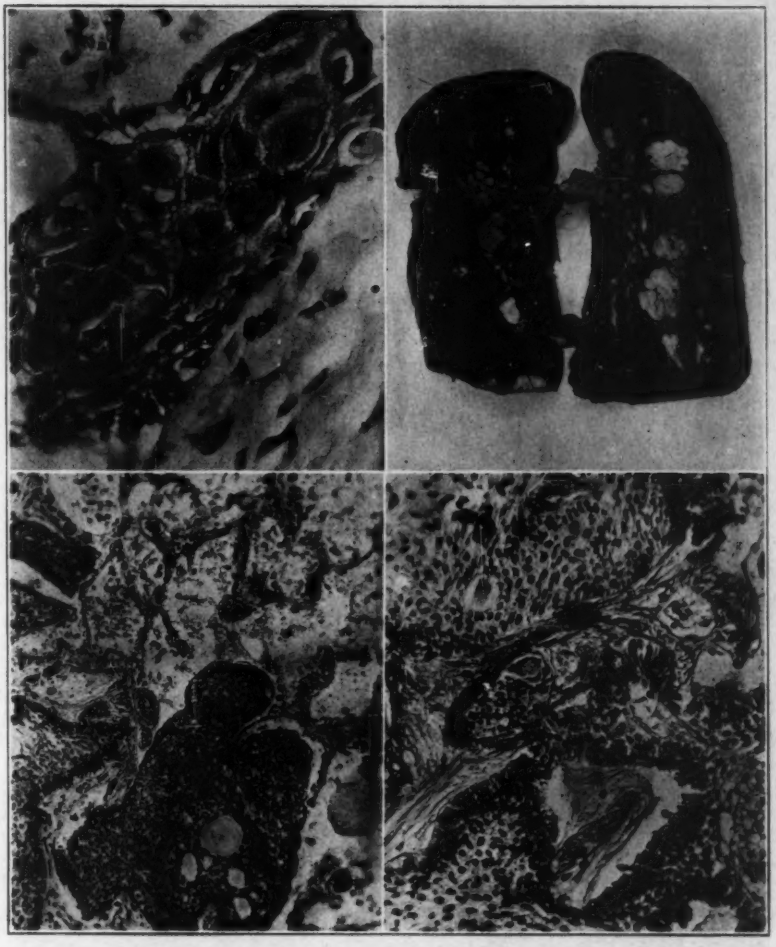

Fig. 2.—A: Nodule in subdural space. B: Tumor in lungs. C: Tumor in lung. (Hematoxylin and eosin; ×110.) D: Tumor in lung. (Verhoeff elastic stain; ×225.)

exploratory operation was performed and the tumor was found extending beneath the temporalis fascia, eroding through the skull and exposing the dura mater. Although a large part of the tumor was removed, additional tumor was found involving the zygomatic bone, which was consequently removed. Tumor was found and removed from the antrum except posteriorly, where it was attached to the roof of the mouth. The diagnosis was recurrent ameloblastoma.

From January 1938 to March 1941, the patient was treated on seven occasions for various complaints and complications of the tumor. A roentgenogram

of the chest taken March 10, 1939, revealed soft tissue metastasis to each lung field. An operation was performed September 16, 1940, and a large part of the tumor involving the left maxilla and zygoma was removed, but additional tumor was found extending behind the eyeball and the prognosis was considered grave.

September 20, 1941, the patient was admitted to the St. Louis County Hospital because of loss of vision in the left eye of five weeks' duration. Roentgenograms taken at this time disclosed destruction of the left sphenoid area with extension to the frontal bone, lateral wall and floor of the orbit, left maxilla and left ramus of the mandible. A palliative operative procedure was carried out in which the left eye and lateral wall and floor of the orbit were removed. Through the operative incision, the tumor was seen to be firmly adherent to the dura mater. A diagnosis of recurrent ameloblastoma was made from the tissue removed at operation.

On her final admission to the St. Louis County Hospital, September 8, 1942, the patient complained of pain and uncontrollable bleeding of the left side of the face of thirty hours' duration. Although hemostasis was secured by ligation and excision of the left external carotid artery, the condition became progressively worse and the patient died, the twenty-fifth day in hospital.

The final clinical diagnosis was ameloblastoma of the left side of the head with metastasis to the lungs.

Necropsy.—Necropsy was performed seven hours after death. The body was well developed, but emaciated and dehydrated. There was a deep oval excavation of the left side of the face and neck extending from the root of the orbit to the level of the third cervical vertebra and from the nasal septum to the infratemporal crest. The bones and soft tissues which normally occupy this area were absent. The tongue, pharynx and tissues around the cervical vertebral bodies were exposed. The base of the wound was grayish white, moist and granular. With the exception of the lungs, the thoracic and abdominal viscera were not remarkable. The significant observations were as follows:

There was an eroded area in the dura mater overlying the great wing of the left sphenoid which measured 5 mm. in diameter. This area of erosion was firmly attached to the leptomeninges of the base of the left frontal lobe of the brain. A section through this region disclosed a small thin-walled cavity filled with yellow purulent material extending 15 mm. into the cortex of the left frontal lobe of the brain. The dura mater lining the left side of the anterior and middle fossae of the skull was elevated by grayish white tissue, which replaced the orbital plate and the great wing of the left sphenoid. (Figs. 1, C and D and 2, A.) In the same region, numerous grayish white nodules measuring up to 9 mm. in diameter projected into the subdural space. Step sections through the brain revealed no other gross pathologic changes.

The posterior and apical regions of both pleural cavities were obliterated by firm grayish white tissue. Each pleural cavity contained 15 cc. of sanguinous fluid. Numerous grayish white firm raised nodules were seen and palpated in all lobes of the lungs. On cut section, these nodules bulged from the surrounding parenchyma, measuring up to 8 cm. in diameter. (Fig. 2, B.) Some of the nodules were rosette shaped and had centrally situated cavities which contained thick gray tenacious material. Although the condition of the trachea,

major bronchi and pulmonary vessels was not unusual, many of the tertiary bronchi were surrounded by grayish white firm tissue. No tumor was observed in the tracheobronchial or bronchopulmonary lymph nodes.

Histologic Examination.—Histologic examination of one of the nodules which projected into the subdural space disclosed essentially the same type of tumor as was observed in the previously described operative specimens (Fig. 1, D) except that, in one area, the tumor cells lining the cystic spaces were markedly enlarged, the cytoplasm was eosinophilic, the nuclei were enlarged and the nucleoli were unusually prominent. Intracellular bridges and concentric masses of keratin surrounded by flattened cells were also observed in this area. (Fig. 2, A.)

Histologic examination of the tumor in the lungs revealed it to be morphologically identical with the tumors described in the operative specimens. (Fig. 2, C.) Verhoeff's elastic tissue stain of several sections of lungs disclosed ameloblast-like cells within the lumens of blood vessels. In several places, the blood vessel walls were fractured and a continuous sheet of tumor cells filled the lumen and extended across the fracture site. (Fig. 2, D.)

The diagnosis was ameloblastoma of the left mandible; extension of the ameloblastoma to the soft tissues and bones of the left side of the head; infiltration of the ameloblastoma beneath the dura mater of the left anterior and middle fossae of the cranial cavity, with extension into the subdural space; abscess of the left frontal lobe of the brain, and metastasis of the ameloblastoma to all lobes of the lungs and to the pleurae.

COMMENT

A careful review of the literature disclosed thirty-two reports of malignant ameloblastomas. These reports were divided into two groups: ten reports in which metastasis had occurred, and twenty-two reports of malignant ameloblastoma without metastasis. The first group has been discussed in the introduction to this paper. In the remaining twenty-two reports, the term "malignant" was employed to convey a variety of meanings. For example, some authors[12, 13, 14, 15, 16, 4, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26] used the term to denote extensive infiltration and destruction of soft tissue and bone by the tumor. In other reports,[12, 13, 14, 15, 16, 17, 19, 27, 20, 21, 23, 24] the word "malignant" was employed to designate metaplasia of the ameloblastoma in addition to local infiltration and destruction of soft tissue and bone. Neither of these uses of the term "malignant" is acceptable since, by definition, a malignant tumor is one that metastasizes.

The statistical studies on these thirty-two collected cases were handicapped in some instances by the incompleteness or inaccessibility of the case reports. The average age of the patient when the tumor was first noted was 36.5 years as compared with the average for all cases of 37.6 years, as determined by Robinson.[27] The sex of one-third of the patients was not stated, but in the remainder the ratio of men to women was 2 : 1, in contrast with Robinson's ratio, 5 : 4. No reliable figures were obtainable regarding the average total duration of the tumors. Racial studies were

likewise unsatisfactory in that only six reports contained information regarding the race of the patients. Of these six patients, five were Caucasians and one was a Negro. Kegel[21] found a ratio of 11:1 when the Negro was compared with the Caucasian. The primary sites of the tumors in the thirty-two collected reports were as follows: sixteen in the mandible, thirteen in the maxilla and one in the orbit. In two reports, the primary site was unknown. These figures are in sharp contrast with Robinson's data in that he found 83.7 per cent in the mandible and 16.3 per cent in the maxilla as an average for all ameloblastomas. It is also apparent from the data collected on these thirty-two cases that the primary site of the tumor bears no apparent relation to the probability that the tumor will invade the calvarium.

It will be recalled that, on the basis of the various authors' histologic descriptions and illustrations of metastatic tumors, four out of ten reports of ameloblastoma with metastasis were not acceptable. Furthermore, in a group of twenty-two cases reported as "malignant" ameloblastoma without metastasis, twelve cases were considered by their authors to exhibit prosoplasia. The studies of Hahn,[28] Glasstone,[29] Sutro and Pomerantz[30] and others were of considerable value in attempts to explain the remarkable histologic variations of these tumors. These investigators have grown tooth-forming tissue extra-orally by implantation and have found that when whole tooth buds were transplanted, the morphologic characteristics were retained, but when only the enamel epithelium was transplanted, the transplant had the pattern of squamous epithelium. From these observations, it would seem that only in the presence of the connective tissue of the dental papilla can the ameloblasts assume their normal form. As isolated cells, they develop into stratified squamous epithelium.

Of unusual interest in the case reported in this paper is the mechanism by which the ameloblastoma in the mandible reached the lungs. The three recognized routes from the mouth to the lungs are the air passages, the blood stream and the lymphatic channels. It is impossible to rule out an aerogenous type of metastasis in this patient, since she was subjected to twenty-four operative procedures over a period of fourteen years. Aspiration is a well-recognized hazard of gaseous anesthesia, and this fact makes it well within the realm of possibility that, at some time during an operative procedure, small particles of the tumor became detached and were carried down the bronchial tree. Against the aerogenous mechanism of metastasis in this case are the absence of any demonstrable tumor tissue within the lumens of bronchi and the fact that tumor nodules were diffusely scattered throughout all lobes of the lungs instead of being restricted to the lower lobes. Such a distribution is in sharp contrast with the case reported by Vorzimer and Perla in which the entire tumor was restricted to the lower lobe of the right lung.

Metastasis by way of the lymphatic system also seems improbable, since

no tumor could be demonstrated in the lymph nodes or lymphatic vessel of the neck and thorax. It is our belief that the ameloblastoma recorded in this report metastasized to the lungs by way of the blood stream, since the capillary bed of the lungs constitutes the first obstacle to tumor emboli arising in the veins draining the head and neck. Additional support for the hematogenous mechanism of metastasis lies in the observation of tumor cells within the small blood vessels of the lungs. In several instances, the walls of these vessels were invaded and sheets of tumor cells were seen growing through the walls. Such evidence does not constitute proof that the ameloblastoma metastasized to the lungs by way of the blood stream, but it is proof that the ameloblastoma has the ability to invade blood vessels.

SUMMARY

In an ameloblastoma of the mandible in a Negro woman aged 23, the tumor recurred locally despite twenty-four operations and involved the maxilla and calvarium and metastasized to the lungs. The metastasis to the lungs appeared to be by way of the blood stream. Thirty-two cases of "malignant" ameloblastoma with and without metastasis were collected from the literature.

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RECENT EXPERIENCES WITH SKELETAL FIXATION IN FRACTURES OF THE MANDIBLE

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SEVERAL articles have recently appeared describing the various forms of apparatus employed in skeletal fixation of fractures of the mandible. These are very ably summed up in the excellent paper by Waldron and his collaborators.[1]

We wish first of all to make one correction in this article. Figure 1, page 60,[1] depicts the Roger Anderson fracture assembly, and it is erroneously described as the Converse-Waknitz technic. Credit for this particular apparatus should be given to Brig. Gen. Leigh C. Fairbank and Lt. Col. (now Col.) Roy A. Stout, Dental Corps, U. S. Army, who worked it out in collaboration with the Tower Company, of Seattle, Wash. Since then, the manufacturers of the Roger Anderson apparatus have adapted this particular form of clamp attachment to all of their appliances for fractures of the long bones. It differs in many respects from, and is much simpler in design than, that used by Converse and Waknitz. The basic principle of all types of apparatus of this kind was formulated originally by Parkhill,[2, 3] who, in 1897 and again in 1898, described the successful use of his "bone clamp" in fourteen cases involving various long bones of the body. Figure 1 shows Parkhill's apparatus as illustrated in one of his articles, and indicates a very close resemblance to appliances at present in use.

Our experience has been with two types of apparatus:

1. The Roger Anderson type, as designed by Fairbank and Stout, and supplied to the U. S. Army. (Fig. 2.)

2. An improvised apparatus suggested by Carl W. Waldron, which utilizes the upper clamp of a 4-inch surface gage (Fig. 3) to connect the pins with the bars by tightening the thumb screw. Connecting rods can be made of steel or clear acrylic material, which is lighter in weight than steel and can be bent after heating.

INDICATIONS FOR SKELETAL FIXATION

Briefly put, the only indication for use of the method in the mandible is, in our opinion, the control of fragments where teeth are absent or do not afford adequate attachment for intra-oral appliances. Under these circum-

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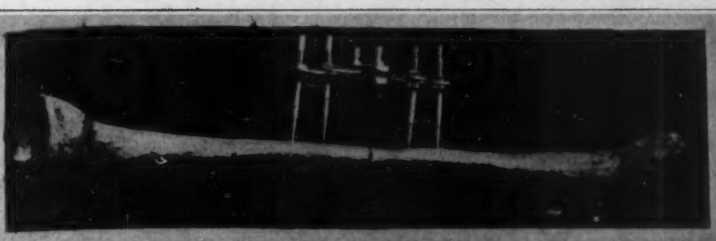

FIG. 2.—Side view of clamp in tibia.

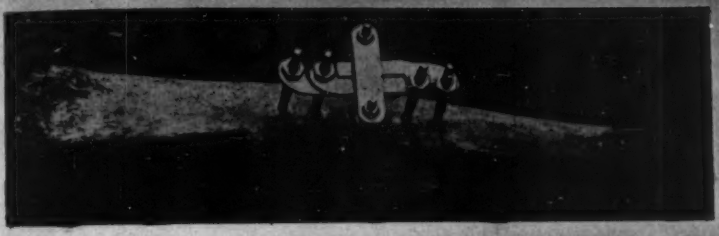

FIG. 3.—Top view of clamp in tibia.

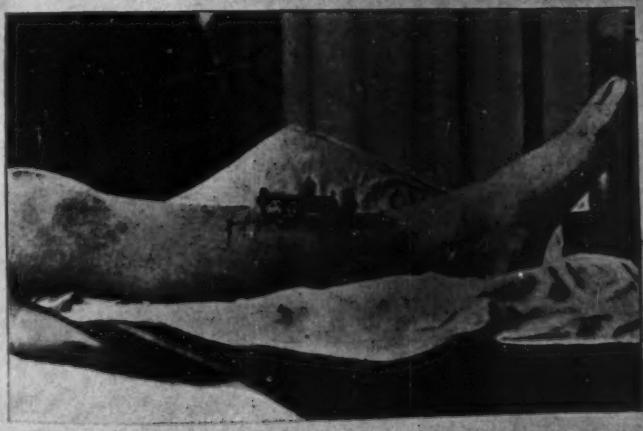

FIG. 4.—Appearance presented at first dressing, six weeks after application of clamp to a fracture of the tibia.

Fig. 1.—Parkhill's bone clamp. Close resemblance to present forms of apparatus is evident. (From Ann. Surg., 1898.)

stances, it is extremely valuable. It should not replace the regular methods of intra-oral fixation when teeth are available, because the very exact occlu-

Fig. 2.—Roger Anderson type apparatus, as designed by Fairbank and Stout, for use by U. S. Army.

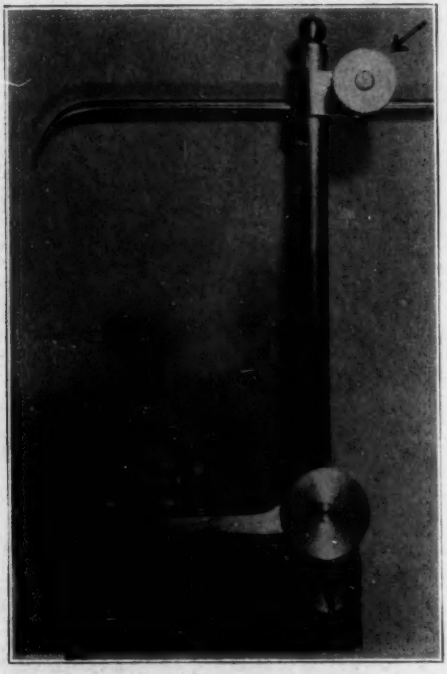

Fig. 3.—Four-inch surface gage, upper clamp of which has been adapted by Waldron for connecting bone pins to external bars.

Fig. 4.—Waldron's apparatus assembled in case of mandibular fracture with long edentulous posterior fragment, before reduction.

Fig. 5.—Case shown in Figure 4, after reduction of fragment.

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sal relationships demanded when teeth are present cannot be assured by any methods other than those depending on the teeth for attachment. In using the method for control of one edentulous fragment, skeletal fixation should be supplemented by dental fixation, or at least elastic control for the other fragment, if teeth are available. (Figs. 4 and 5.)

TECHNIC OF OPERATION

Strict asepsis is necessary, and the outer operative field must not be contaminated by oral secretions or contact with fingers and instruments

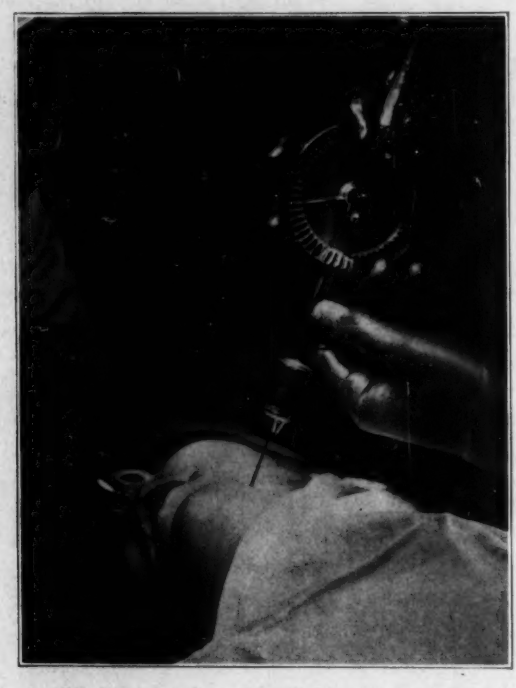

Fig. 6.—Pin driven into bone through skin with hand power drill.

that have been in the mouth. This is important. The method, therefore, is not safe in the hands of those trained only in intra-oral surgical technic. The skin over the lower jaw is prepared just as for any other surgical operation.

Stainless steel wire pins, 0.080 gage, are ground to a triangular point, and threaded about one-third inch from the point upward. The pin itself is used to make the hole in the bone, and is mounted in a hand-driven

Fig. 7.—Pins firmly fixed in one fragment at correct angle for good retention.

Fig. 8 (Case 1).—Waldron appliance with acrylic bars in place.

"egg-beater" type drill. The pins should be placed as near the lower border of the mandible as possible, the two pins in each fragment forming an angle of about 45 to 60 degrees. The pointed end of the pin, mounted on the hand drill, pierces the skin and is passed in through the soft tissues

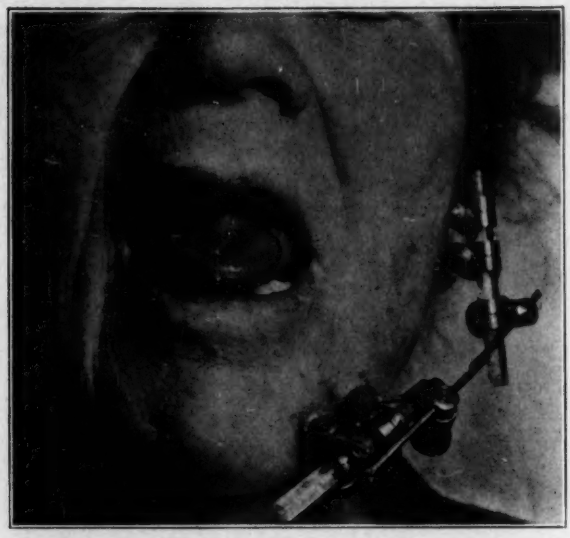

Fig. 9 (Case 1).—Opening of mouth possible with appliance in place.

Fig. 10 (Case 1).—Skeletal fixation appliance and fragments in good alinement.

until it reaches the outer plate of bone. (Figs. 6 and 7.) It is then made to puncture the bone by slow rotation until the point engages the inner cortical plate. During insertion of the pins, an assistant, by the use of fingers and retractors in the mouth, holds the fragments steady, taking particular care not to contaminate the external operative field with his fingers. It is inadvisable to drill the holes first and then try to insert the pins, because it is difficult to find the holes.

The holes also should not be bored with an electrically driven instrument

Fig. 11 (Case 2).—Extent of laceration and exposure of internal structures of face.

because of (1) difficulty in gaging the depth, and (2) the possibility of devitalization of surrounding bone by the heat. After the pins have been firmly seated in each fragment, the assistant hold the fragments in correct alinement while the operator adjusts the external connecting bar and tightens the clamps. If strict asepsis has been followed, there is little irritation or seepage around the pins and they will remain firmly in the bone for the required period of about six weeks. Usually, they have to be unscrewed in order to be removed.

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Two recent cases in which this method has been successfully used are reported.

REPORT OF CASES

CASE 1.—M. McH., a woman, aged 68, was injured in an automobile accident, January 8, 1943, receiving a deep lacerated wound along the left side of the lower jaw and a compound fracture of the mandible in the first molar region. All existing teeth were in very poor condition, and no teeth were present in the fragment on the left side behind the fracture, this fragment being ele-

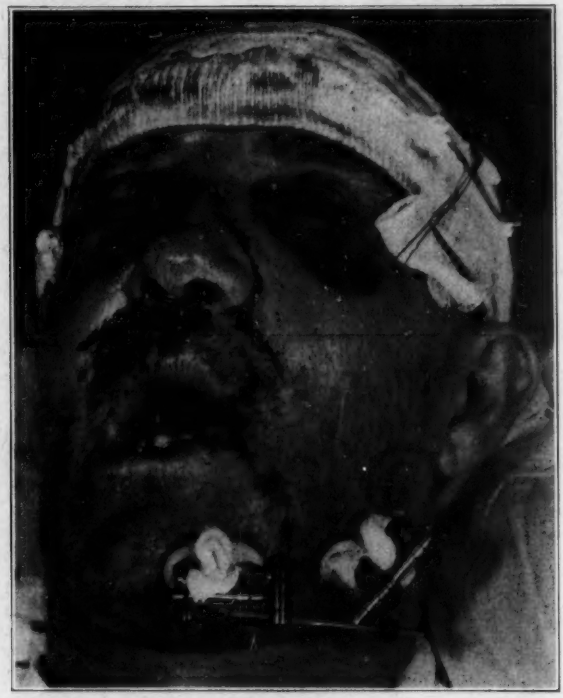

Fig. 12 (Case 2).—Case after replacement of nose and suture of soft tissues. Wires are seen emerging near the outer canthi of the eyes, running from the upper teeth to bars on the plaster headcap to hold the maxilla up in position. (Waldron skeletal fixation apparatus for fracture of mandible.)

vated. January 14, under pentothal sodium intravenous anesthesia, two stainless steel pins were driven through skin into each fragment of the mandible, each pair of pins being connected with short bars of acrylic material by means of surface gage clamps, according to the technic of Waldron. The elevated posterior fragment was held down in position by pressure within the mouth, while

the two pairs of assembled pins were connected with a steel bar, the displaced fragment being thus fixed in good position. (Figs. 8, 9 and 10.) The appliance remained in place until March 1, 1943, when it was found that the pins were still firmly imbedded in the bone. The pins were then removed by unscrewing with forceps, and the fracture was found to be united and the fragments in good position.

CASE 2.—*History.*—R. F., a man, aged 50, of slight build, seen March 17, 1943, had inflated the inner tube of a 10-ton trailer-truck tire, which he had just repaired, to 90 pounds when the clincher rim blew off and struck him full in the face, knocking him flat. Within ten minutes, he was in the accident

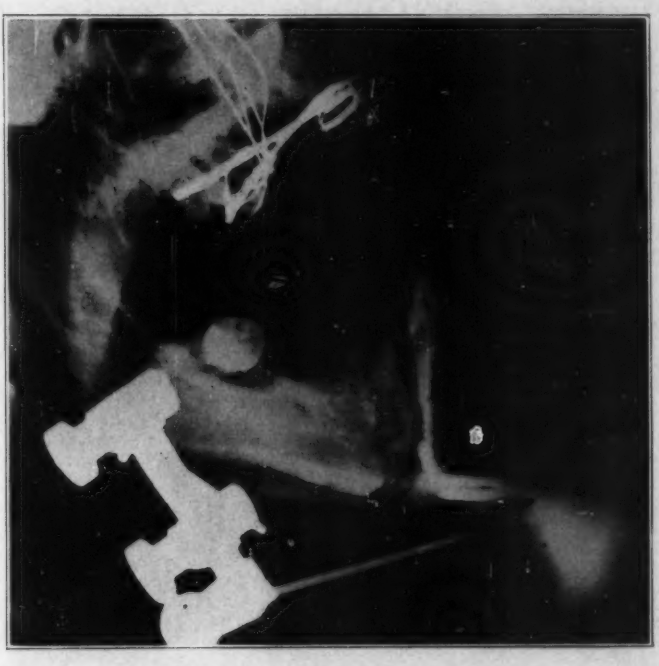

Fig. 13 (Case 2).—Pin fixation apparatus in place.

ward of the Graduate Hospital, and Dr. Curtis saw him within another fifteen minutes.

Examination.—The patient's face had been split open, as though with an axe, on a diagonal line passing from the inner rim of the right orbit to the region of the left mental foramen of the lower jaw. The line of cleavage passed through the upper area of the bridge of the nose, left nasolabial fold, upper lip, corner of the mouth and lower lip and chin. The right anterior ethmoidal cells, the nasal fossa and the left maxillary sinus were all widely exposed and the lacerations of the upper and lower lips extended through into the mouth.

(Fig. 11.) There were multiple fractures of several bones: the orbital and perpendicular plates of the right ethmoid; the right lachrymal; the outer rim of the orbit at the junction of the frontal process of the malar and the malar process of the frontal bones; the nasal bones, and the anterior part of the left turbinate. The entire upper jaw was freely movable, separating from the malar and nasal bones on both sides. The hard palate with its mucous membrane was split wide open and there was a transverse fracture of the right segment of the upper jaw in the first molar region. There was a comminuted fracture of the lower jaw through the left mental foramen and directly connected with the lacerations of the skin and mucous membrane in that area.

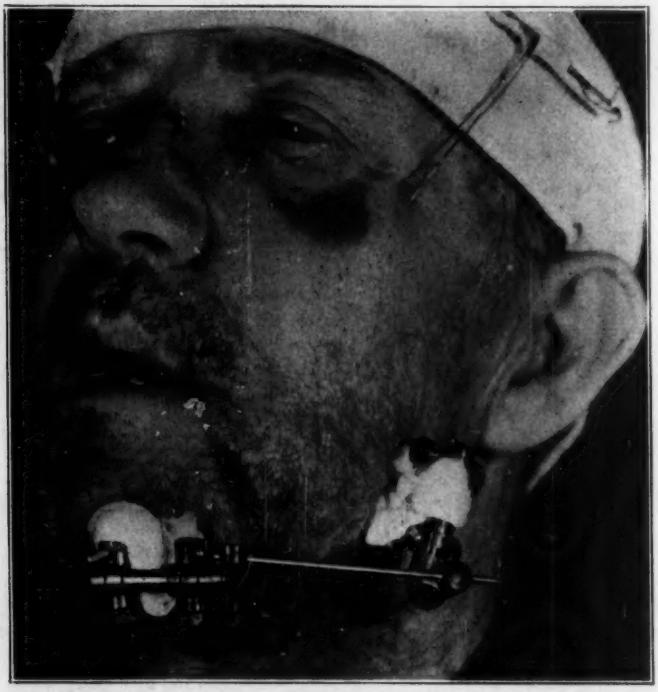

Fig. 14 (Case 2).—Later photograph of patient, showing progress in healing of external wounds.

Preoperative Measures.—Immediately after his entrance into the hospital, the patient was given 250 cc. of plasma and 500 units of tetanus antitoxin. The bleeding was temporarily controlled by hot saline packs, and the patient was sent up to the operating floor after an injection of one-fourth grain of morphine and one one-hundredth grain of scopolamine.

Operations.—Bleeding was permanently controlled by ligating the left angu-

lar and mental arteries, and the grimy, greasy face was cleaned with benzine. The soft tissues and exposed bones were flushed with a warm saline solution and then oriented. All fractured fragments of bone were, fortunately, either covered by or partially attached to soft tissues, with the exception of a sliver in the mandibular area, and were therefore saved. It was apparent that a plaster headcap would be needed for fixation, and it was applied at this time.

The entire upper jaw was displaced downward and backward, and the right side, with its additional transverse fracture, was further displaced downward nearly 2 cm., the right eyeball dropping with it. There were but three teeth in the upper jaw—a molar and canine in the right half, a molar in the left. A german silver half-round arch bar, gage 15, was securely attached to the right molar and canine. A similar bar was extended from the right canine to the left molar and was so constructed as to close the cleft in the palate. A loop of 24-gage brass wire, 12 inches in length, was passed around each bar as near the molars as possible and the free ends were passed upward through the cheeks, emerging through small incisions 1 cm. outward from the external canthi. The fragments of the upper jaw, and consequently the right eyeball, were elevated into position and the wires fastened to coat-hanger bars in the plaster headcap, and thus secured.

In the belief that the patient had had enough for one day, it was decided to close the soft tissues, and attached pieces of bone, and take care of the lower jaw in a day or two. Sterile granular sulfanilamide was sprinkled throughout the gaping facial wound from glabella to beneath the chin. Small rubber tissue drains were inserted in the anterior ethmoid cells, the nasal fossa and the upper and lower lips. The free edges of the wound were clean and not torn and were approximated with fine braided silk interrupted sutures. Those fragments of bone that were attached to the soft tissues went nicely into place. The nasal bones and the inferior turbinate were held in place by light packing of the nasal fossae with plain gauze saturated with mineral oil. The injection of procaine into the free edges of the tissues had minimized the pain and 500 cc. of 5 per cent glucose in a saline solution was given intravenously during the operation. The patient was in good shape when he left the operating room.

The posterior fragment of the fractured mandible was edentulous and was thus elevated. Two days later, March 19, under sodium pentothal intravenous anesthesia, a Waldron skeletal traction splint was applied, fixing the fragments in position; an ideal situation for the use of this splint. It is important that the fragments be correctly alined before the several gadgets are finally tightened. The four rubber tissue drains were removed at this time. (Figs. 12, 13 and 14.)

Outcome.—April 2, the headcap was removed and all bars and wires connected with the fixation of the upper jaw were taken off. The soft tissue wounds had healed completely by first intention with the exception of a small fistula beneath the lower border of the mandible in line with the fracture. The patient was discharged from the hospital April 6, twenty days after his admission.

We were naturally concerned about the condition of the right eye. After the fractured parts of the upper jaw had been reduced and fixed to the headcap, the eyeball was automatically nearly restored to its normal position. Edmund

B. Spaeth examined this eye immediately after the first operation. I quote from his final report on the day of the patient's discharge from the hospital: "He had a period of brief double vision which, I believe, was due to retrobulbar hemorrhage and not connected with any true oculomotor paralysis. His vision at the start was impaired slightly, but this has cleared up very well. The fields of vision are normal as well. At the time of discharge from the hospital, the vision was 6/9—2 on the right and 6/6—2 on the left. The fundi showed no ocular pathosis."

The external splint was removed April 23, five weeks after its application. Both union and the position of the fragments were good. At the time of writing, May 20, the fistula has healed and the patient has been temporarily discharged, in good condition. A slight secondary correction of the scar through the lower lip will undoubtedly be necessary at some future time.

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Treating the Patient.—Time and again, when, in various parts of the world, I have found myself ill or injured and confined to bed, I have been attended by doctors who never even found out that I had any medical training; in fact, they never found out anything about me at all. They were concerned to treat "The Injury" or "The Disease" and not me, the patient; they were in short dealing with a pure abstraction and thinking that they were being very scientific. The more I have seen of life and death, of pain and suffering, the more clearly I have realized that there is never in the real world outside the walls of the Medical School and teaching hospital "A Disease" to be treated; there is never "An Injury" to be dealt with; there is just a sick child, woman, man to be helped to get well. In short, the real business of clinical medicine is not science. It is, in the case of each sufferer, a personal relationship into which sincerity and medical knowledge are suffused by the physician, and trust and some dependence by the patient.—Sir Auckland Geddes, in J. A. M. A.

UNDIAGNOSED PRIMARY CARCINOMA OF THE GINGIVA WITH WIDESPREAD METASTASES: REPORT OF CASE*

LESTER W. BURKET,† D.D.S., M.D., Philadelphia, Pa.

EPULIDES are sessile or pedunculated tumors arising from the marginal gingival tissues or dental periosteum. A malignant lesion confined to the gingival margin is so unusual that many times epulides are not examined microscopically for possible malignancy. The failure to consider every growth as being potentially malignant until the contrary is proved may result in embarrassment to the clinician and more serious consequences to the patient.

The case herein reported illustrates the need for a thorough examination of the oral cavity regardless of the symptoms for which the patient seeks medical attention, as well as the necessity for ruling out the possibility of malignancy of any lesions found.

REPORT OF CASE

History.—V. K., a man, aged 57, admitted to the New Haven Hospital April 25, 1931, complained of weakness, dyspnea on exertion and pain in both legs, the symptoms dating back to February, when the patient had been admitted elsewhere for diabetes. Roentgenologic examination made at this time revealed changes in the vertebrae in the region of the ninth and tenth dorsal. Hospitalization was advised for further observation and diagnostic procedures. During his stay in the New Haven Hospital, the patient gradually became weaker, until he was confined to bed. The weakness was most marked in the lower left extremity. Pain was also present along the rib margins. Codeine and acetylsalicylic acid at first afforded relief, but it was finally necessary to resort to morphine.

Examination.—The patient was well developed and well nourished. The blood pressure was 180 systolic, 80 diastolic; temperature, 99.6°F.; pulse, 95, and respiration rate, 20 per minute. No sinus or mastoid tenderness was elicited. The pupils reacted to light and in accommodation, but both optic disks were on a level with the rest of the retina, the left disk being irregular in outline. The vessels were markedly tortuous, with a round area of hemorrhage in the right eye. Cursory examination revealed no reduction in the visual fields.

The teeth were dirty and in poor condition. (Intern's report.) The tongue could be extended in the midline without tremor. No unusual findings were

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*Material collected and studies made under a Sterling Fellowship in Pathology, Graduate School of Medicine, Yale University, 1935-1936.

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noted in the neck and chest. Cardiac enlargement, murmur or irregularity was absent. The lower pole of the left kidney was barely palpable; otherwise, the abdominal examination was negative.

A neurologic consultant suggested the possibility that an intramedullary cord lesion was responsible for the dissociated sensory symptoms. Lumbar puncture yielded a clear fluid with fifty-three red cells and eight white cells (lymphocytes) per cubic millimeter, a 2 plus Pandy reaction and negative Wassermann and colloidal gold reactions.

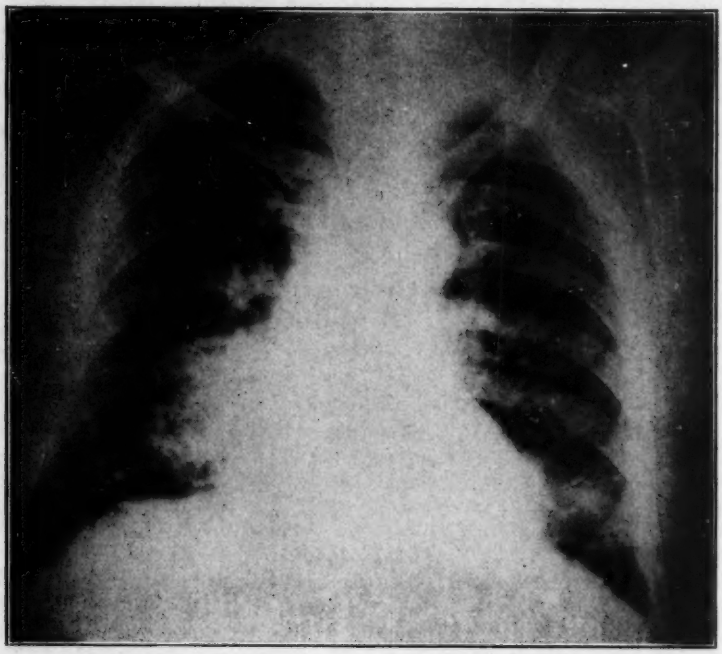

Fig. 1.—Density in right lower lung field.

Proctologic and cystoscopic examinations revealed no abnormalities. The spine, skull and pelvis were examined roentgenographically. No evidence of a metastatic process was observed in the skull or pelvis, but the roentgenologic appearance of the body of the tenth dorsal vertebra suggested a destructive process not unlike that seen in neoplastic metastases.

Chest films taken May 21 showed a localized area of partial consolidation in the right lower lung field, more or less triangular, with its base toward the root of the lung. (Fig. 1.) The increased density in the lung field was heterogeneous and its roentgenologic appearance was compatible with a clinical diagnosis of hypoventilation of the lower lobe associated with primary bronchogenic malignancy.

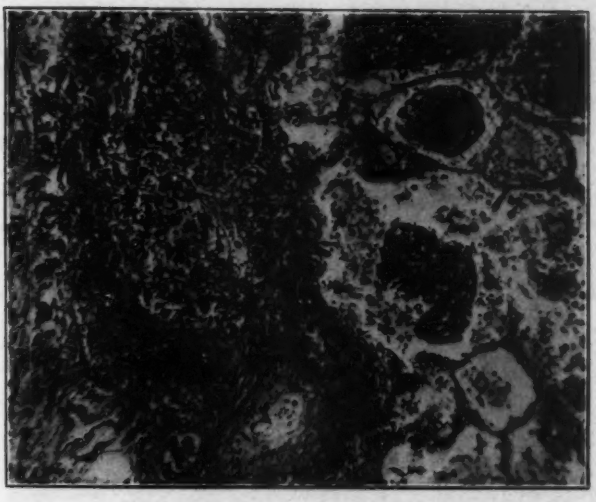

Fig. 2.—Tumor metastases in lung (×35.)

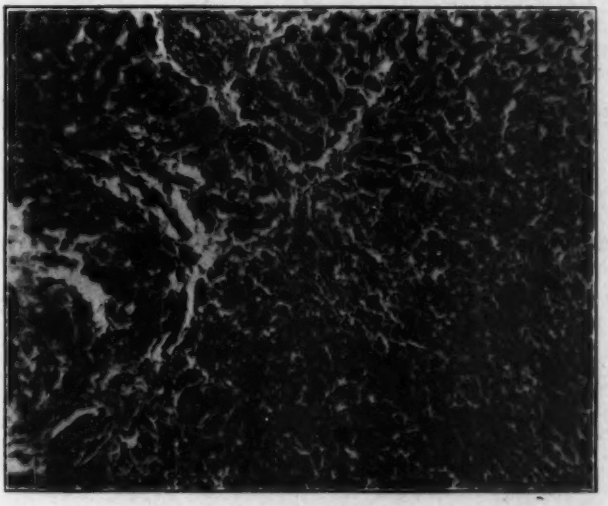

Fig. 3.—Tumor metastases in liver. (×35.)

Operation.—May 22, a laminectomy of the eighth, ninth and tenth dorsal vertebrae was performed. The patient's condition was poor at the conclusion of the operation and he died two days later.

Clinical Diagnosis.—The diagnosis was carcinoma of the bronchus, with metastases to the tenth dorsal vertebra, and diabetes mellitus.

Positive Necropsy Findings.—Examination of the oral cavity revealed a small mass measuring 1 by 1 cm., projecting from the gums just behind the lower right second bicuspid. It was firm on palpation and covered with smooth mucous membrane. It presented no ulcerated areas. Palpation indicated that the superficial lymph nodes, particularly the mandibular and cervical, were not enlarged.

Numerous raised translucent gray masses were observed on the peritoneal surface covering the fundus of the bladder and the liver. On palpation, all lobes of both lungs were crepitant. The hilar nodes were tremendously enlarged and firm on pressure. Cross-section revealed numerous circumscribed, translucent and opaque foci appearing to be metastatic carcinoma lying within

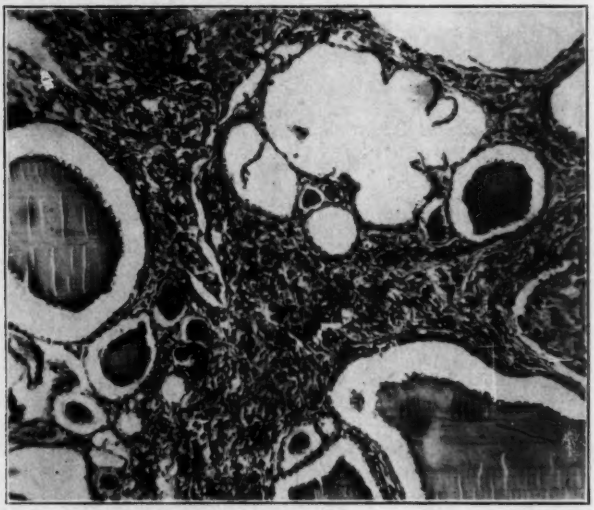

Fig. 4.—Tumor metastases in thyroid. (×35.)

the substance of the gland. The main bronchi, as well as their main branches, were opened *in situ*. No ulceration of the mucosa or primary focus of carcinoma could be demonstrated. Other bronchi and bronchioles were opened in an attempt to find a focus for the metastatic nodules, but nothing suggestive of a primary bronchial growth could be seen grossly. On cross-section of the lungs, numerous metastatic foci averaging 0.3 to 1 cm. in diameter were found in the substance of the right lung. Only two or three similar appearing nodules were present in the left lung. No evidence of metastasis was observed in the parietal pleura of either organ. Metastatic nodules were noted in the pancreas, liver, adrenals and kidneys, and the right lobe of the thyroid adjacent to the trachea was also found to contain a metastatic nodule.

Microscopic examination of the epithelium lining the right main bronchus showed that, in places, the single layer of columnar cells had been replaced by bizarre-shaped epithelial elements forming papillary projections. The cells were arranged in a haphazard manner and in no instance suggested glandular structures. The nuclei of the tumor cells assumed a great variety of shapes and sizes. They were observed in the submucosa and muscular coat and in the neighboring alveoli, some of which were filled with compact masses of these cells. (Fig. 2.) Most unusual were the large numbers of blood vessels partially or completely occluded by metastatic tumor elements. Neither the gross nor the histologic findings in the bronchi were characteristic of primary carcinoma of the bronchus.

Fig. 5.—Growth on lingual marginal gingiva. (×5.)

Microscopic studies of the other organs confirmed the malignant nature of the nodules observed grossly. (Figs. 3 and 4.) In addition, metastases were demonstrated in the lymph nodes near the celiac axis.

Anatomic Diagnosis.—Primary: The primary diagnosis was apparent carcinoma of the bronchus (right) with metastasis to the abdominal and thoracic

Fig. 6.—Tumor infiltration in lingual marginal gingiva. (×35.)

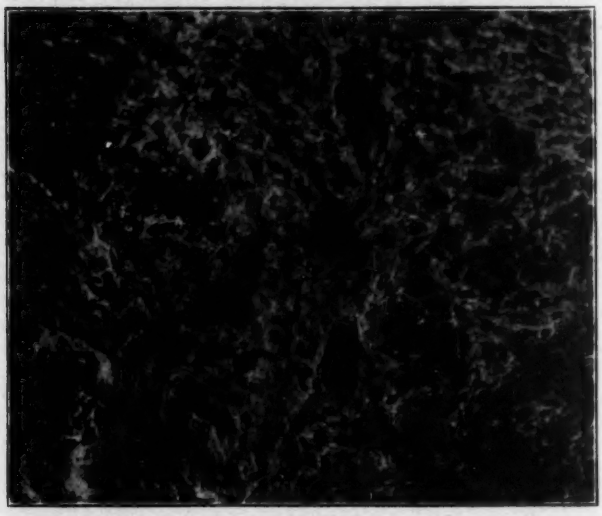

Fig. 7.—Tumor infiltration in lingual marginal gingiva. (×85.)

lymph nodes, liver, lungs, kidneys, adrenals, diaphragm, thyroid and bladder, and the bodies of the ninth and tenth dorsal vertebrae, spinal cord compression, and dilation of the urinary bladder.

Secondary: The secondary diagnosis was epulis (diagnosis of gross lesion by general pathologist).

Oral Pathology.—Gross: The specimen obtained at necropsy consisted of that portion of the mandible containing the lower left second incisor, lower right second incisor and first and second premolar teeth. The labial marginal gingiva about the lower right second premolar, canine, second incisor and left second incisor was dark blue, granular and opaque. A firm deep-red tumor mass approximately 1.5 by 2 by 3 cm. was attached to the lingual marginal gingiva adjacent to the above-mentioned teeth. (Fig. 5.) The major portion of the growth lay posteriorly from the lower second incisor tooth.

Histopathologic Studies: Approximately six months after the general pathologic studies and the gross oral pathologic examination, histologic sections of the jaws and teeth were available for study.

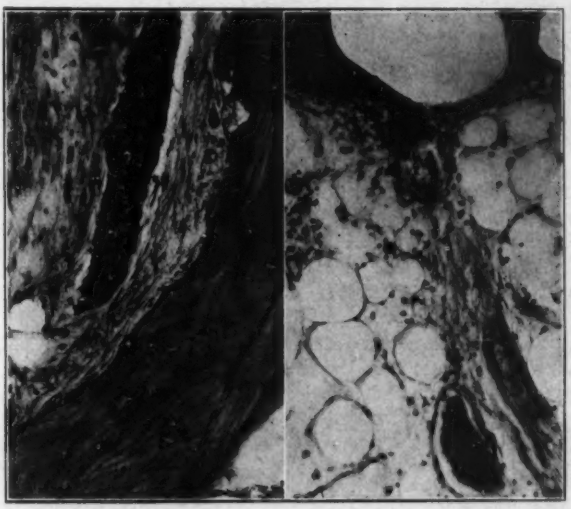

Fig. 8.—Tumor cells in vessels and vessel walls of alveolar marrow substance. (×85.)

Lower right second incisor: Gross: A poorly fitting gold shell crown, serving as a bridge abutment, covered the visible portion of this tooth. A slight amount of calculus and débris was present about the tooth. A polypoid mass, previously described, was attached to the lingual marginal gingiva.

Bacteriologic examination: Material was removed from the alveolar bone about the apex of the tooth for bacteriologic examination. Growth of an anaerobic *Streptococcus viridans* was obtained.

Roentgenologic examination: The lamina dura could not be distinguished as the opacity of the root blends with that of the adjacent alveolar bone. A radiopaque cone was present in the central portion of the root, extending 1 or 2 mm. beyond the shadow cast by the apex. The alveolar crests were markedly

flattened and irregular and the alveolar bone surrounded only the apical half of the root. A definite radiopaque area over the clinical crown suggests a metallic restoration.

Histologic examination: Gingiva: There was a slight amount of intracrevicular and extracrevicular débris, most marked on the lingual aspect. The epithelial attachment was entirely on the cementum. The stratum corneum was irregular and ulcerated near the marginal gingiva. A large epidermoid growth was attached to the lingual marginal gingiva by a small pedicle the superficial surface of which was ulcerated and devoid of cornified epithelium. The epithelial cells, which were supported by a fine stroma of connective tissue, were arranged in a haphazard manner and they were bizarre as to shape. They were mostly vesicular, a few being pyknotic or multilobed. They all varied in respect to size and staining qualities. The outline of the cytoplasm, which stained a light violet to pink, varied, depending on the compactness of the cells and their location. Numerous finger-like processes extended from the stratum cylindricum down into the tunica propria, which contains numerous small isolated masses of atypical epithelial cells. (Figs. 6 and 7.) There was a slight accumulation of small round cells throughout the tunica propria.

Alveolar bone: There was a marked flattening of the alveolar crests with lacunae formation on the lingual aspect. Here, the cortical plate was thick as compared with that on the labial aspect. The compact layer of the alveolar bone surrounding the tooth was continuous with the cortical bone on the lingual aspect, and contained many large lacunae in some of which were multinucleated cells. The compact layer of the alveolar bone about the tooth on the labial aspect was thin and had a wide, diffuse blue-staining border. Numerous isolated masses of atypical epithelial cells were present in the marrow spaces, and in the mandibular canal about the large nerve bundles. In some instances, the cells were observed to involve the vessel walls or to lie free in the vascular channels in the marrow spaces. (Fig. 8.) In other places, the marrow spaces were filled with large adipose tissue cells. The remaining dental tissues presented no remarkable findings.

COMMENT

This case illustrates the need for a thorough and careful examination of the oral cavity regardless of the symptoms for which the patient seeks medical attention. In spite of their usual benign nature, growths arising from the marginal gingiva should always be considered malignant until proved not to be.

It is believed that there is sufficient evidence in this case to establish that the marginal gingival growth was the primary source of the widespread metastases. This was the combined opinion of the general and oral pathologists. The oral pathologic findings were added to the necropsy report and the final diagnosis was modified accordingly. This case illustrates the importance of careful oral pathologic examination as an aid in interpretation of the more remote pathologic findings.

OSTEOMYELITIS OF THE JAWS

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THE mandible is subject to osteomyelitis five or six times as often as is the maxilla, and it is approximately the eighth bone in frequency of involvement. This serious infection of the jaws, which is not uncommon, may occur at any age, even before the eruption of the deciduous teeth. It is seen more frequently between the ages of 10 and 40 and occurs about three times as often among males as among females. Unlike osteomyelitis of the long bones, which is more frequently of metastatic origin, the jaws are but very rarely involved by hematogenous infection. Primary infection by trauma or secondary involvement by the extension of infection from the dental area or from contiguous infection accounts for the large percentage of the cases seen in practice. The great frequency of dental infection of the four types, root-end, periodontal, pericoronal and residual, constitutes the chief factor in the development of the infection of the bony substance of the jaws.

BACTERIOLOGY

The presence of *Staphylococcus aureus* is usually the principal cause of osteomyelitis, though streptococci and pneumococci may be the agents responsible. Secondary and mixed infections are common.

CLASSIFICATION; ETIOLOGY; GENERAL CONSIDERATIONS

I. Primary cases develop by direct infection of the bone through trauma, such as compound fractures caused by falls or blows, or gunshot wounds. They may follow operative manipulation such as the surgical wiring of the mandible in fracture cases, or the excision of cysts and tumors, especially carcinoma of the type associated with severe infection. The pathogenic organisms are carried into the bone by the injury or the surgical procedure.

II. Extension cases may occur from infection of the attached soft parts by the spread of infection to the periosteum from a furuncle of the chin. This may occur spontaneously, but is more likely to develop with an associated traumatism such as a blow or after the incision of an abscess when the knife is thrust too deeply and infection is carried into the periosteum. Similarly, osteomyelitis of the mandible may result from the extension of an acute infection of the floor of the mouth, the peritonsillar region or fascial planes, to involve the periosteum, and produce thrombosis of the blood vessels.

Read before the Section on Oral Surgery and Medical Relations at the Seventeenth Annual Midwinter Meeting of the Chicago Dental Society, February 20, 1941.

Extension cases may also occur from infected lesions of the gums or alveolar mucoperiosteum, such as ulcers.

Odontogenous cases develop from pulpal, apical, periodontal, residual or pericoronal infection. The infection may spread to the bony substance of the jaws through the deeper or more superficial portions of the jaw or tooth sockets, or, in pericoronal cases, by involvement of the periosteum.

Odontogenous osteomyelitis may occur:

1. Spontaneously.

2. After dental operative interference, such as an extraction, scaling or incision of infected pericoronal gum flaps; after dental treatment plus the application of drugs such as phenol, arsenic and hydrogen peroxide, or after the packing of extraction sockets.

Fig. 1 (Case 1).—Osteomyelitis of mandible (May 10, 1938) six weeks after onset (April 1, 1938).

Injection of procaine into an area of infection may result in a periostitis, which may extend to produce an osteomyelitis.

Systemic conditions such as diabetes, tuberculosis, syphilis, severe anemia and leukemia, and drug poisoning by mercury, bismuth or phosphorus may predispose to osteomyelitis of the jaws of the odontogenous types.

X-ray and radium treatments of the associated soft parts, such as the chin, lips, cheek, tongue and pharynx, may cause an endarteritis and interference with the normal circulation and local resistance of the jaw and investing tissues. This condition predisposes to the spread of odontogenous infection and the development of an indolent type of subacute and chronic osteomyelitis, which may run a prolonged course before final resolution.

III. Hematogenous (metastatic) osteomyelitis of the jaws may be associated with a primary osteomyelitis of some other bone or with primary infection of superficial or deeper tissues. In the mandible, the site of the initial involvement is usually the ramus, and the condition is unassociated with odontogenous infection; whereas, in the maxilla, the onset is usually associated with the eruption of teeth. Hematogenous osteomyelitis is more likely to occur in infants and young children, but may occur late in life in severe illnesses, or may develop at the site of an unerupted tooth. The infection of the jaws occurs during the course of a bacteremia, the latter resulting from an acute bacterial lesion of some part of the body that is the portal of entry for the infection. The sites of primary infection may be areas of the skin, the entire mucous membrane, the gastro-intestinal tract, the genito-urinary

Fig. 2 (Case 1).—Condition two weeks later (May 27, 1938), showing extensive osteomyelitis of ramus.

tract, surface lesions, usually furuncles or carbuncles, the tonsils and other lymphadenoid areas.

Hematogenous infection of the tissue of the jaw occurs in association with various conditions:

1. Osteomyelitis resulting from the ordinary form of local infection, such as is manifested by boils and furuncles, is comparatively rare. Many cases, however, have been reported.

2. Osteomyelitis following or coincident with infectious diseases of severe types, such as typhoid fever, influenza, measles, scarlet fever, smallpox and pneumonia, though rare, is somewhat more frequently seen than that resulting from furuncles.

3. Osteomyelitis in nurslings and infants aged 2 weeks to 9 months has a very high mortality.

4. Hematogenous osteomyelitis may occur in adults at the site of unerupted teeth, usually in the lower jaw, with typical sequestration of portions of the alveolar process. The unerupted tooth may be buried deeply in the bony tissue. The clinical course includes the usual manifestations up to and including sequestration, separation and exfoliation of the necrotic portions of the jaw. Subsequent closure of the wound or the sinus does not occur until the unerupted tooth is removed at operation. A hematogenous infection takes place in the bone tissue surrounding the cavity of the unerupted tooth, the latter possibly forming the determining factor in the point of localization.

5. Chronic bone abscesses of the jaws occurring without any demonstra-

Fig. 3 (Case 1).—Condition seven months after onset (November 1, 1938), showing complete regeneration of molar region and infection and sequestration of angle and ramus.

ble dental source of the infection have been recorded. The only explanation of the cause of this rare condition is hematogenous infection, and the mechanism of the localization and development of the infection within the bony substance of the mandible is not understood.

PATHOLOGIC CONSIDERATIONS

In fracture or surgical exposure of bone in the presence of acute infection, the first pathologic change results from the introduction of infection into the open vascular channels in the bone. This produces thrombophlebitis at the site of the fracture or surgically exposed area. The pathologic changes that ensue and the intensity of the loss are dependent on:

1. The type and virulence of the infecting micro-organisms and of the opposing antibodies.

2. The amount of disturbance of blood circulation and thrombosis.

3. The character and degree of the consequent deprivation of the bone cells of food, which determines the extent of bone necrosis.

The amount of bone involved in the inflammatory process and the resulting necrosis varies considerably. When free drainage is secured and maintained, the secondary thrombosis or blockage of channels does not tend to spread to channels of larger size and the number of bone cells that eventually die and the amount of bone that becomes devitalized as a result may be relatively small. If a major trunk becomes thrombosed, larger amounts of bone may sequestrate. The condition is more or less dependent on the fact that large sections of the mandible receive their blood supply through multiple arterial

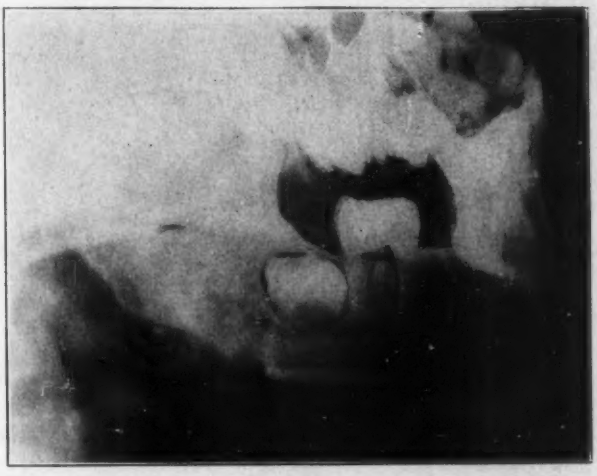

Fig. 4 (Case 1).—Condition nineteen months after onset (November 10, 1939), showing complete regeneration of body of mandible with progressive development of permanent teeth. Slight infection and sequestration continue in the ramus.

loops derived from a single vessel. Consequently, if the inflammatory process involves the main vessel, the death of that portion of the bone which it supplied will usually result. Ordinarily, such infections do not remain confined in the jaw for any length of time, owing to the fact that the cortical plate of the jaws and the lamina dura of the tooth sockets are usually relatively thin and do not ordinarily provide much resistance to the suppurative process. Therefore, the inflammatory exudate tends quickly to find a point of exit for spontaneous drainage of the bony tissues. When this is established, the acute phase of the condition usually subsides into the subacute form, which in turn fades into the chronic form, in which the retention of

sequestra or the presence of bone cavities may maintain suppuration over a prolonged period of time.

THE BLOOD CIRCULATION OF THE MANDIBLE

The mechanism of extension cases arising from infection of attached soft parts is largely dependent on the circulatory relationship of the jaws and associated tissues.

The blood supply of the lower jaw is obtained from (1) the nutrient (inferior dental) artery and (2) the periosteal circulation derived from contiguous muscular and other arterial trunks.

The periosteal blood supply is very abundant, and individual vessels must necessarily be involved when there are inflammatory lesions in the soft parts surrounding the bone. These vessels may undergo thrombosis, and an ex-

Fig. 5 (Case 2).—Postero-anterior view (June 9, 1931), showing complete removal of deciduous teeth of mandible and presence of developing permanent teeth.

tension of the infection along the thrombosed vessels follows as a matter of course. If such an infected thrombotic process spreads inward sufficiently to enter the confines of the jaw, an osteomyelitis results, and the resulting thrombosis of the blood vessels is followed by a corresponding necrosis and sequestration. This seems to occur much more readily on the external surface of the mandible as evidenced by the frequency of sequestration of the buccal portions of the jaw in comparison with sequestration of the lingual plate. It seems that periostitis and associated cellulitis on the lingual side of the mandible are less likely to cause extensive thrombosis with invasion of the lingual surface of the bone.

UMI

The vascular arrangement for the upper half of the ascending rami of the mandible is as follows:

The coronoid and condyloid processes and the contiguous part of the ramus are supplied with blood by a number of arterial branches derived, for the most part, from the internal maxillary artery. This blood supply has very slight collateral anastomosis with the blood supply of the remainder of the mandible, as represented by the blood supply derived from the inferior dental arteries.

Sequestration of the coronoid or condyloid processes of the ramus is uncommon. This probably has some relation to the greater frequency of odontogenous factors in the production of osteomyelitis of the body of the lower jaw. In most cases, drainage becomes established spontaneously or by incision to relieve the inflammatory process before the associated periostitis

Fig. 6 (Case 2).—Postero-anterior view seventeen months later (November 1, 1932). The developing permanent teeth were removed to clear up a chronic suppuration.

and cellulitis involving the body of the mandible have spread by direct extension to the periosteum of the upper part of the ramus, the condyle and the coronoid process. Consequently, the blood supply of the condyle and coronoid is but rarely interfered with to the extent that thrombosis develops, with subsequent necrosis and sequestration. Occasionally, a severe fulminating periostitis and cellulitis may spread upward from distal pericoronal infection in the third molar region following extraction of the tooth, or after a severe blow or the application of crushing pressure in the region of the angle of the mandible. The course of the inflammatory process may be so severe that the resultant thrombosis and circulatory blockage cause the head

of the condyle and the coronoid process, and more rarely portions of the zygomatic arch, to become necrosed and sequestrate. An infected penetrating wound and compound fracture of the condyle and ramus may occasionally result in osteomyelitis and necrosis. This region may also be involved by the spread of a severe acute infection, from a peritonsillar abscess, the third molar area of the upper jaw, the maxillary sinus or mastoid region, or infections of the deeper fascial planes.

SYMPTOMS

The symptoms of the onset of acute osteomyelitis of the jaws vary considerably. When they are associated with a dental operation such as the extraction of teeth, there is usually evidence of a local reaction within a few hours. Pain, swelling, elevation of temperature and general malaise in-

Fig. 7 (Case 2).—Lateral view (November 1, 1932), showing marked retrusion and deformity.

crease hour by hour. In the occasional fulminating case, the condition may progress rapidly to a fatal termination. Usually, in a few days, sufficient drainage is established to lower the temperature and lessen the pain. Then ensues a long period in which there is more or less sufficient drainage, and ultimately sequestra become loosened and are removed before final healing takes place. During this period, there may develop subacute or even acute excerbation due to partial or complete closure of sinuses with blockage of the drainage or to minor extensions of the osteomyelitic process. When the condition arises in the course of a systemic infection, the general symptoms of osteomyelitis may be masked by those already present, and the condition may be recognized only by the local signs. If osteomyelitis occurs as a com-

plication of a fracture or of some operative procedure in which the wound is wide open, there may be little disturbance other than the local swelling, pain and progressive loosening of the teeth, with the appearance of a purulent discharge.

DIAGNOSIS

The history and systemic clinical findings, when accompanied by the intra-oral signs and symptoms of acute osteomyelitis of the body of the mandible, make possible an accurate diagnosis long before x-ray examination is of much service. The obviously progressive extension of swelling of the periosteum of the alveolar process and associated tissues, when accompanied by an increasing loosening of teeth in succession, with the appear-

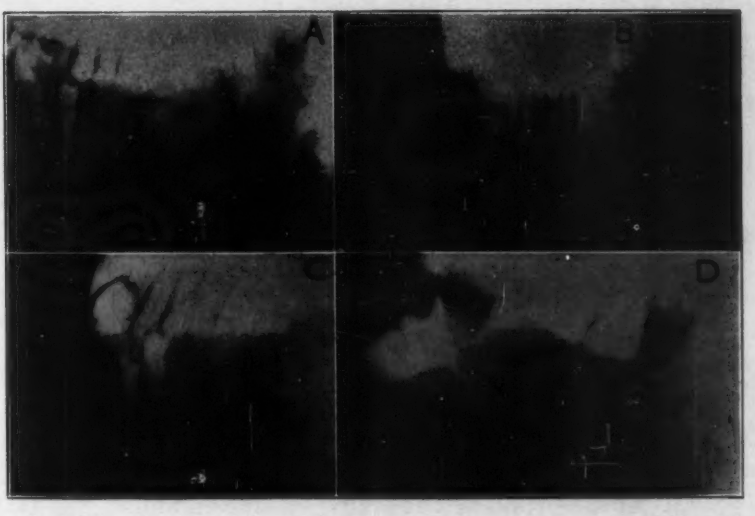

Fig. 8 (Case 3).—A, right lateral view taken October 2, 1925, two and one half months after onset; showing sequestration. B, postero-anterior view two and one half months after onset; showing osteomyelitis extending from condyle to condyle. C, right lateral view taken November 9, 1925, three and one half months after onset; showing separation of large sequestrum. D, right lateral view, one year later (1927); showing regeneration of body and alveolar process ridge of mandible.

ance of suppuration from the gingival spaces, is proof of the presence of osteomyelitis. This fact makes possible the prompt institution of treatment to provide drainage, which usually limits the spread of the inflammatory process.

In the early acute stage, the roentgenogram rarely, if ever, reveals any positive changes in the detail of the alveolar process trabeculation, although the probable source of the infection, such as one of the types of odon-

togenous infection, may be seen. About the third week, a blurring may be noticeable, and later the alveolar process and ramus may have a so-called moth-eaten appearance. During the second month, progressive decalcification of the bone becomes apparent, and, as time progresses, the roentgenograms will reveal larger areas of decalcification and the presence of irregular sequestra. The amount of decalcification may be most alarming because it frequently appears that a pathologic fracture has occurred in the mandible without any clinical evidences of a fracture. Such an area of decalcification is, of course, very weak and subject to fracture on slight traumatism or even on strong mastication. As time progresses, the roentgenograms show increasing calcification of areas of the bone that had previously shown complete decalcification with loss of all normal details of bony structure. In from six to eight months, x-ray examination usually reveals almost complete

Fig. 9 (Case 5).—Lateral view, showing extensive osteomyelitis and sequestration two months after onset, which followed extraction of third molar with pericoronal infection. Ten vital teeth were lost.

regeneration of bone, although complete resolution may be delayed for months or years, in which case the roentgenograms will show infected bone cavities or retained sequestra.

The roentgenogram is of great service in the diagnosis of certain cases of atypical chronic osteomyelitis of the proliferative type with condensing osteitis.

The prevention of most cases of osteomyelitis of the jaws is intimately associated with the increasing activity of the dental profession directed toward the maintenance of optimum oral hygiene and the control of dental

caries. The prevention of periodontal and root-end infection will therefore greatly reduce the incidence of osteomyelitis. The most important remaining problem will then be the control and treatment of pericoronal infection about erupting or impacted third molars.

The fact that the greater percentage of cases of acute osteomyelitis of the jaws develop subsequently to dental procedures has resulted in a great deal of criticism by many surgeons who have contributed to the literature of this subject. For this reason, a detailed discussion of the problems is indicated. It must be appreciated that acute infections go through a stage of increasing virulence of the pathogenic bacteria responsible for the process. This stage is accompanied by an increase in the local signs and symptoms of the inflammatory process. During this period, the local and systemic defensive processes are building up to combat and overcome the infection. A period of from four to ten days usually is required to bring the defensive processes to a maximum state of efficiency.

Fig. 10 (Case 6).—Osteomyelitis of lower border of mandible extending forward to bicuspid region, after extraction of third molar with pericoronal infection (September 16, 1939).

These considerations should govern the handling of acute infections of the teeth, jaws and associated soft parts of the mouth and face. It is a well-known fact that osteomyelitis develops much less frequently in patients who have not had surgical treatment; whereas, in the majority of cases of acute osteomyelitis, there is a history of extraction of a tooth or incision of an acutely inflamed area. Such operative procedures open the vascular channels of the bone of the tooth socket or periosteum and expose them to direct infection by the pathogenic organisms from the root-end area, a periodontal pocket or a pericoronal area. When this infection of newly opened vascular channels takes place during the early stages of an acute infectious process, the increased virulence of the organisms may result in a rapidly extending inflammation of the bone.

UMI

It is, of course, a fact that extractions of teeth are performed in great number in the presence of acute infection with accompanying periostitis, cellulitis and beginning abscess formation without the subsequent development of osteomyelitis or other serious complications; but this does not justify a disregard of surgical principles, founded upon the clinical experience of competent oral surgeons, which, in turn, is based upon the scientific study of infection. One preventable case of osteomyelitis, with prolonged disability, in an individual practice of dentistry is one too many. It is hardly possible to outline a set of rules that would cover all oral surgical conditions, but some of the principles of handling such cases that have proved eminently satisfactory might well be discussed. In routine extraction of teeth presenting chronic or subacute periapical infection, great care should be exercised in curetting granulomatous tissue from the tooth socket. The curetting should be more of a peeling-out process than forcible scraping of the bone, in order

Fig. 11 (Case 6).—Condition one month later (October 16, 1939): pathologic fracture through first molar region necessitating extraction of first molar.

to avoid opening normal alveolar process bone and subjecting it to infection from the root-end area. The same careful technic is indicated for the removal of infected periodontal tissue present in pyorrhea pockets. Needless to say, operating under direct vision with good illumination and as dry a field as can be secured by sponging or suction are essential to good surgical procedure.

This brings us to the discussion of the all-important controversial problem of extraction of teeth in the presence of acute inflammation and swelling. In the early stage of an acute periapical infection, there may be present a slight swelling of the tissues overlying the jaw that is merely a slight lymphatic edema without demonstrable swelling or induration of the periosteum. In my experience, prompt extraction at this stage under general anesthesia

has not been followed by any serious postoperative complications. Sulfadiazine or sulfathiazole should be administered about four hours before extraction. If examination shows a definite periostitis with extra periosteal cellulitis and inflammatory induration, extraction of the offending tooth should be delayed, as it would open up the vessels of certain normal portions of the tooth socket to the pathogenic organisms from the root-end or gingival area. Furthermore, the extraction of the tooth does not provide adequate drainage of that portion of the infective process that has extended through the bone to involve the periosteum and extraperiosteal cellular tissues. The treatment should be directed toward localizing the suppurative process and providing drainage. This may be accomplished by frequent moist spot heating applied externally or hot spot irrigation with hypertonic salt solution intra-orally, depending on the localization of the extraperiosteal infection. Central softening or fluctuation is usually demonstrable within

Fig. 12 (Case 6).—Postero-anterior view (October 16, 1939), showing osteomyelitis and pathologic fracture of mandible.

two or three days, and careful incision by the Hilton method usually results in drainage and subsidence of the swelling and the relief of symptoms. During this period, anodynes and sedatives should be administered to relieve or reduce the pain and discomfort. The advisability of employing sulfonamide therapy by the administration of sulfanilamide, sulfapyradine, sulfadiazine or sulfathiazole is now sufficiently established to suggest its frequent use by members of the dental profession either systemically or locally in tooth sockets or other infected areas. Intelligent systemic administration is dependent on precise bacteriologic data and a knowledge of the absorption and excretion of these drugs. A constant concentration of the drug in the blood is essential to the maintenance of its bacteriostatic therapeutic activity, which is independent of the immune mechanism of the body. Toxic

symptoms due to the drugs may be alarming and serious and it would seem necessary that any prolonged administration should be under the direction of a skilled physician. Furthermore, these drugs are of doubtful value in well-established localized staphylococcic lesions such as carbuncles or abscesses, or in osteomyelitis. In severe cases, the use of these drugs may prevent the spread of the infection to healthy tissues and may maintain a sterile blood stream.

Research in sulfonamide therapy for various conditions is being intensively carried out in many universities and we may expect further valuable contributions to our methods of combating and controlling infection. Some of the authorities on this subject are of the opinion that these drugs will prove to be of great value in the field of prevention of the spread of infection. Therefore, I should recommend, in cases of acute infective peri-

Fig. 13.—Compound fracture of mandible; injudicious surgical bone wiring and circummandibular wiring with insecure interdental wiring that failed to hold teeth firmly in occlusion.

apical pericementitis, the administration of 30 grains of sulfathiazole or sulfadiazine, which will assure an adequate blood concentration in four hours. At this time, the extraction of the tooth becomes a much safer procedure in the event the pathogenic micro-organisms are of a more virulent type. Four or five additional doses of 15 grains at four-hour intervals should be given after the extraction. Toxic manifestations of sulfonamide therapy such as nausea, vomiting, dermatitis, drug fever and hematuria are not likely to occur as a result of the administration of this amount of the drug. Elliot's research demonstrated that blood infection occurs in approximately 70 per cent of cases of multiple extraction of teeth with gingival and

periodontal disease, and in 34 per cent of cases when three or more teeth are extracted in the absence of detectable gum disease. Fortunately, such blood infections are usually transient and have no demonstrable ill-effects. Some preexisting abnormality may render an organ or a tissue, such as a joint or the heart valves, liable to infection after extraction. This research emphasizes the necessity of dentists' giving greater attention to these problems and establishes the advisability of preoperative sulfonamide therapy in acute or subacute dental infections. The local application of sulfanilamide powder to the tooth socket is apparently of service, although reports concerning its usefulness are conflicting.

Many reports were published during 1942 and 1943 on the clinical use of penicillin in serious infections and in infections in bone. This is best administered in seriously ill patients by means of a constant intravenous

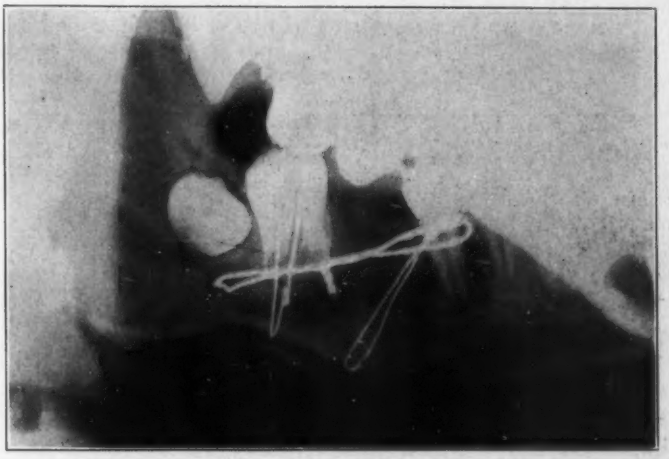

Fig. 14.—Case shown in Figure 13; two weeks later. Osteomyelitis has resulted from the unnecessary and ill-advised method of treatment.

drip, which seems to be more effective than any other method of treatment for severe acute infections caused by *Staphylococcus aureus* and *Streptococcus pyogenes,* such as may be found in acute fulminating osteomyelitis, cellulitis and bacteremia. In less acute and chronic cases, sterile penicillin (the filtrate) is suitable for local application in infected wounds and for irrigation of sinuses. It is soluble in water, penetrates tissue and is neither toxic nor irritating to mucous membranes.

Fortunately, its local use in subacute and chronic conditions requires but a small fraction of the amount necessary for intravenous or intramuscular therapy in gravely ill patients.

The limited quantity of penicillin now being produced is reserved for

research and for the Armed Forces. It will probably not be available for general use until after the war and then only if research into its complex structure makes its synthetic production possible at a reasonable cost. It has been stated that if this is accomplished, sulfonamides may disappear from use. The use of penicillin at present for moderate infections and those that readily respond to other antibacterial agents would seem wasteful.

Within a period of a week after incision and drainage, the local and systemic condition will usually be sufficiently improved to permit extraction of the infected tooth with but little danger of acute osteomyelitis. By this time, the imbalance between the virulence of the infection and the resistance of the patient will usually have become reestablished in the patient's favor.

Acute pericoronal infection of the mandibular third molar regions is of great etiologic importance in acute osteomyelitis. The pain, swelling and distress accompanying such conditions may so upset the patient that he will not listen to reason and will insist upon immediate incision or the extraction of the tooth, refusing conservative treatment, until, at last, he finds a dentist willing to accede to his wishes.

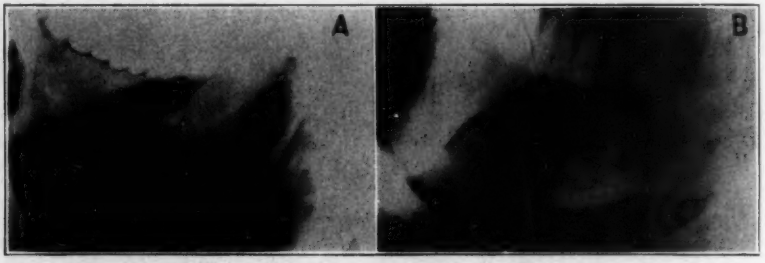

Fig. 15.—A, lateral view of extensive osteomyelitis in man aged 40. B, condition six months later: excellent regeneration, but sequestra retained in bicuspid region and at angle.

My routine treatment of pericoronal infection is as follows:

A hot intra-oral irrigation with hypertonic salt solution or magnesium sulfate solution is used every hour or two until relief is evident. After each irrigation, a drop or two of an acceptable aqueous antiseptic solution may be instilled between the gum flap and the crown of the tooth. In selected cases, irrigation beneath the gum flap using a blunt hypodermic needle may hasten resolution. Vincent's infection may complicate the acute condition, requiring special treatment. During this period of conservative treatment, the patient should be inactive, and it is usually necessary to employ sedatives and anodynes to control the pain, reduce the discomfort and assure sleep and rest. Should cellulitis and abscess formation occur, treatment is instituted to localize the suppuration, followed by incision and drainage. Several weeks of freedom from acute or subacute infection of a pericoronal

area should be allowed to elapse before the removal of the tooth is undertaken.

It should be stressed that an acute pericoronal infection is essentially a soft tissue infection that does not primarily involve the periodontal tissues or the tooth socket proper. It is obviously poor surgical procedure to open the vascular channels of the bone by extracting the offending tooth until the virulence of the micro-organisms has been greatly reduced and the defensive and immune mechanisms of the patient have been strengthened.

This rather lengthy consideration of the treatment of acute conditions that are potential sources of osteomyelitis brings us to the treatment of osteomyelitis proper.

Early and adequate drainage of the area of infection is the most important consideration in the acute stage. This should be accomplished with the

Fig. 16.—Lateral view of chronic osteomyelitis and sequestration of four years' duration in woman aged 24.

least possible surgical trauma. Incisions may be made intra-orally to open subperiosteal areas of pus or extra-orally to provide drainage of abscesses within the cellular tissues and between the periosteum and the lower border of the jaw. Suppurative matter on the lingual surface may require a free incision to prevent further separation of the periosteum. This provision for drainage may be sufficiently adequate to assure a marked improvement in the local and systemic conditions. Such drainage is, of course, extramandibular and does not *per se* drain effectively the infected areas within the bone. This may be indicated especially when the infection has spread

centrally through the bone from a periapical area, and particularly when thick cortical bone has offered resistance to drainage. In such cases, two methods of providing drainage to the deeper portions of the bone are available: (1) the extraction of teeth to provide access through the tooth sockets and (2) incisions through the buccal mucoperiosteum or in the submandibular region, and drilling through the cortical plate in several places. The mental foramen should be avoided by making two incisions if the infection extends anteriorly.

The method of choice is dependent on many conditions and considerations related to the individual patient and the accumulated clinical experience of the past. The increasingly severe and acute character of the osteomyelitis may warrant such additional operative interference. In the past, in many cases of the acute type, the teeth have loosened so rapidly that they could be virtually lifted out, this measure providing the necessary additional drainage. It has, however, been common to observe a spectacular tightening up of very loose teeth to the normal after resolution of the osteomyelitis has taken place. Dental roentgenograms reveal complete regeneration of the alveolar process and the lamina dura with a normal periodontal membrane line when complete loss of such a supporting alveolar process had been manifest during the acute and subacute phases of the disease. Consequently, when acute osteomyelitis develops from the third molar region, with an otherwise normal complement of teeth, it is obviously desirable to retain the remaining teeth if it is at all consistent with the health and safety of the patient. In such cases, should intra-osseous drainage seem necessary, it would be wise to attempt to save the teeth by drilling through the cortical bone well beneath or externally from the root ends of the teeth. I have carried out this procedure in two patients. In both, the improved drainage resulted in prompt relief from the extreme and constant pain, with accompanying reduction of toxemia and improvement in systemic symptoms. I did not, however, succeed in saving a number of badly loosened teeth. In other cases, a dental examination will determine the fact that the extraction of certain teeth to secure better drainage of deeper areas of the bone will not seriously interfere with a satisfactory dental restoration.

With the acute stage fading into the subacute and chronic condition, the surgical problem is maintenance of continued adequate drainage and removal of sequestra as they become separated and loosened. The condition is determined by painstaking probing. Sequestrotomy should be carefully performed, avoiding the use of curets which might damage reparative granulations or newly forming bone or might expose adjacent bony tissue, with extension of the osteomyelitic process. By such conservative handling of these cases, new bone formation proceeds apace while the necrosed portions of bone are becoming separated. Ordinarily, necrosed bone will become detached and loosened within ninety days, but it is not uncommon

to see several sequestra in one patient become separated and loosened at intervals of several weeks. Delay in the separation of sequestra, even of a year or more, is not uncommonly seen when osteomyelitis of odontogenous origin develops after radium or x-ray treatment of malignant tumors of the mouth, tongue and lips. In such cases, it often becomes necessary to remove surgically the sequestrum that has failed to become separated. The injurious effects of irradiation upon the circulation of the bone interfere with the processes that ordinarily produce granulation tissue and form a line of separation, for there is an intermediate zone of bone the vitality of which is markedly impaired, but not lost.

The subsequent effect on normal growth of acute osteomyelitis of the mandible in children may be very serious, and the younger the patient, the greater may be the resulting deformity. The principles of treatment are as already outlined, and conservatism should be the rule. It has been repeatedly demonstrated that the developing permanent teeth and germinal tissues are remarkably resistant to infection and destruction by the osteomyelitic process. The completion of the roots of such teeth proceeds without apparent interruption, and eruption may take place a year or more before the average time. During the acute, subacute and chronic stages of the osteomyelitis, every effort must be made to maintain adequate intra-oral drainage and, if need be, external drainage with frequent irrigation of the sinuses. Exposed crowns of permanent teeth should not be traumatized, for the developmental tissues of the root area continue to function normally even in the presence of considerable suppuration. One must resist the temptation to remove developing permanent teeth for the purpose of further improving drainage until it is apparent that such a step is necessary in the interest of recovery. The radical removal of large numbers of developing permanent teeth will be followed by unilateral or bilateral failure of development, causing facial deformity and retrusion. The resulting disproportion of the mandible and maxilla presents an almost insurmountable problem in restorative dentistry. Every effort should be made to avoid such deformities.

Unilateral deformity, retrusion and deviation of the mandible often result from an osteomyelitis involving the angle of the mandible and ramus when the growth centers in this portion of the jaw are affected. The prevention of this type of deformity is difficult, if at all possible. Efficient but conservative surgical treatment should be carried out to maintain drainage until all suppuration has ceased and sequestra have been removed. Orthodontic treatment may be of service later in promoting growth and reducing deformities. Osteoplastic operations to lengthen the jaw may be undertaken when the patient's growth is attained.

In osteomyelitis, systemic treatment is important. In the acute stage, the severity of the toxemia usually necessitates hospitalization, complete rest in bed and, at times, intravenous therapy and blood transfusion. Sulfonamide therapy should be tried, and vaccines are sometimes useful.

UMI

During the subacute and chronic ambulatory stages, fatigue must be avoided. The diet should be rich in nourishing and protective values and in vitamins. The mineral content should be increased by the use of milk products or by the administration of compounds of calcium, phosphorus, etc. Plenty of fresh air and sunlight, or ultraviolet ray treatment, is helpful.

COMPLICATIONS

Bacteremia and septicemia, which occur occasionally, may have an early fatal termination or result in infectious arthritis, infections of the various body cavities, endocarditis, pericarditis, the presence of renal infarcts or lung abscesses, to which the patient may eventually succumb. Meningitis and brain abscesses are rare complications of osteomyelitis of the jaws, usually resulting in death.

OSTEOMYELITIS OF THE MAXILLA

Osteomyelitis of the upper jaw may occur at any age and is about one fifth as common as osteomyelitis of the lower jaw. In infants and very young children, the maxilla is more often affected than the mandible.

The blood supply of the maxilla is largely derived from the terminal branches of the internal maxillary artery by means of freely anastomosing loops of finer vessels. When but one or two of the lesser loops are thrombosed by the infective process, there results but a minimal loss of bone. When larger main arteries become involved, subsequent necrosis may result in the loss of one half of the maxilla or more.

Odontogenous sources of infection are the most important, the osteomyelitis occurring either spontaneously or in association with dental procedures. All of the etiologic factors detailed in the early part of this paper, primary, extension and hematogenous, are seen in the production of osteomyelitis of the maxilla. Direct infection of the bone by trauma such as compound fracture or by an operation such as an antrum puncture to secure drainage of an infected maxillary sinus may initiate the process. Extension cases may result from lip furuncles, ulcers, maxillary sinus infection or nasal infection unassociated with operative measures.

Systemic states such as diabetes, anemia, leukemia, agranulocytosis, syphilis and tuberculosis and drug poisoning are important predisposing causes of extension of infection from an odontogenous source to produce an osteomyelitis of the maxilla.

Osteomyelitic infection of the maxilla in nurslings and infants, which has been studied at length, is considered as metastatic by many writers, although birth injuries of the upper jaw, or traumatism by the fingers and the nursing bottle have been considered important causative factors. The onset is sudden with marked swelling of the cheek and eyelids on the affected side, and swelling and softening of the gums and palate. There

may be a purulent nasal and conjunctival discharge on the same side. Death may occur within a few days. The pathologic changes are similar to those of osteomyelitis in adults, though modified by the fact that the maxilla of the infant contains a greater percentage of cancellous bone with many tooth buds, some in close proximity with the orbit.

The differential diagnosis is to be made between this form of osteomyelitis and the following conditions: (1) ophthalmia neonatorum, usually a bilateral lesion and in which gonococci can be demonstrated; (2) erysipelas; (3) dacryocystitis, and (4) syphilis.

The treatment of osteomyelitis of the maxilla is essentially the same as that outlined for the mandible, though, of course, modified by the type and extent of a previously existing or a complicating maxillary sinus infection due to the extension of infection from the maxilla proper. In spite of careful treatment, some cases of osteomyelitis of the maxilla may progress and involve the malar bone, orbit and frontal bone, and finally the meninges and brain, ending in the death of the patient. In other cases, the facial cellulitis and thrombosis of the facial vein may produce a cavernous sinus thrombosis, with similar result.

Suppuration in osteomyelitis of the upper and lower jaws may be of very great amount and though usually subperiosteal and extraperiosteal, it may progress in a wide variety of directions in extension and in localization. The anatomic relations of the tissues adjacent to the jaws, the muscles and tendinous attachments and particularly the fascial planes and spaces of the head and neck determine the pathways of infection and the localization of the suppurative process. Many recent studies and contributions to the literature on this subject have added greatly to our knowledge concerning the treatment of suppurative infections of the head and neck.

REPORT OF CASES

CASE 1.—L. C., a girl, aged 6, complained of a severe toothache, of the deciduous second mandibular premolar, beginning about April 1, 1938, and accompanied by marked swelling of the cheek, face and neck. A high fever and toxemia necessitated hospitalization and the intravenous administration of fluids, etc. A submandibular area of cellulitis and abscess was incised and drained on the fifteenth day. The acute phase of the infection subsided, but swelling and drainage persisted. The patient came to our clinic for treatment about six weeks after the onset. The roentgenogram (Fig. 1) taken at this time showed an extensive osteomyelitis of the right side of the mandible involving the bicuspid region, the molar region and the entire ramus. Conservative treatment was instituted in the hope that minimum interference with growth could be assured. Buccal and submandibular incisions were made and the sinuses dilated at intervals. Sequestra were removed when found to be separated and areas of excessive granulation were excised when they interfered with free drainage. (Fig. 2.) These procedures were carried out seven times, usually under nitrous oxide anesthesia, over a period of two and a half years. All the

teeth have been retained except the deciduous premolar and one permanent bicuspid tooth crown that was found badly displaced and inclined horizontally. The infection of the body cleared up and bone regeneration was complete in seven months. (Fig. 3.) Completely adequate drainage of the ramus was difficult and the final healing took place after the removal of a sequestrum, in November 1940. (Fig. 4.) It is believed that the development of the ramus will not be interfered with to any considerable extent.

CASE 2.—A boy, aged 10, seen in consultation, showed the extreme failure of normal development resulting from removal of all but one of the permanent teeth from the mandible in a case of extensive osteomyelitis. This overzealous, though conscientious effort to clear up all sinuses and eliminate infection as rapidly as possible must be condemned except in the rare case in which the general health or life itself seems jeopardized. (Figs. 5, 6 and 7.)

CASE 3.—A man, aged 24, in August 1925 had an acute pulpitis and pericementitis of the left mandibular second bicuspid tooth of several days' duration. A root canal treatment did not afford relief from pain. Extraction under procaine was attempted, and subsequently removal of the fractured retained root of the tooth was accomplished under ether anesthesia. Marked swelling ensued. Fever, toxemia and delirium were manifest within a few days, and the osteomyelitis spread to involve the entire mandible from condyle to condyle. (Fig. 8, A and B.) All of the teeth became very loose and the pus flow from the gingival margins increased from day to day. The molar teeth were extracted (Fig. 8, C) to provide drainage and six external incisions were made to evacuate pus from the submandibular region. Later on, the incisors and cuspid teeth were removed on account of persistent swelling and discharge despite free submental drainage. One bicuspid tooth was left on each side for stabilization of a lower denture, as the patient was a cornetist by occupation. (Fig. 8, D.)

CASE 4.—A man, aged 45, gave a history of periodontal infection. In carrying a 200 pound armature on his shoulder, he stumbled slightly and the armature fell against the side of his face, a contusion resulting. This was followed by swelling, pain, fever and a typical periostitis and osteomyelitis, involving the left molar region, angle and ramus and extending into the head of the condyle. It was necessary to maintain intra-oral and external drainage for approximately eight months. A large sequestrum of the angle and ramus was removed in four months.

CASE 5.—A woman, aged 25, developed an acute osteomyelitis after the removal of a partially impacted, but exposed lower right third molar, at a time when the pericoronal tissue was sore and tender. The process spread anteriorly past the midline to the bicuspid region on the opposite side, with marked localized swelling, loosening of the teeth and excessive granulation. Ten teeth were removed to establish drainage. (Fig. 9.)

CASE 6.—A man, aged 43, gave a history of extraction of a third molar August 1, 1939. Apparently, there was a pericoronal infection present, and for one day there had been marked pain without swelling. Acute osteomyelitis developed August 4, with a temperature of 104° F. and very severe symptoms. The process spread to the lower border and forward to the bicuspid region. (Fig. 10.) A submandibular incision was made, but marked suppuration per-

sisted in the gingival areas. A free incision on the buccal aspect intra-orally afforded temporary improvement. Marked necrosis of the lower border beneath the first molar caused a pathologic fracture, about the sixth week. (Fig. 11.) The teeth were wired in occlusion after the removal of the first molar and sequestra were removed from time to time, with three reincisions of the sinuses over several weeks. (Fig. 12.) Four months after the original extraction, healing was complete and union of the fragments was strong enough for the patient to be placed on a soft diet.

CASE 7.—A man, aged 55, gave a history of extraction of a number of teeth subject to periodontal disease February 20, 1936. Several months later, he developed a subacute, chronic osteomyelitis. There was a history of intensive radiation therapy for cancer of the lower lip two years before. The disease ran a slow indolent course, necessitating drainage and the removal of sequestra. The osteomyelitis improved slowly and healing seemed nearly complete when the patient died of a coronary disease.

CASE 8.—A man, aged 54, seen April 15, presented an extensive cellulitis of the right side of the face and submandibular region. There was a history of removal of a lower molar several weeks before, after which the tooth socket had not healed. It had been reopened on two occasions, with some curettage of the alveolar process. The x-ray film taken April 15 showed an extensive osteitis with considerable loss from the lower border of the mandible. This defect could only be due to destruction from a tumor which was complicated by extensive abscess formation. A submandibular incision was made and a large amount of pus was evacuated. Retraction of the incision margin revealed tissue obviously of the tumor rather than of the inflammatory type. Biopsy confirmed the fact that it was a carcinoma. Though it was apparently inoperable, an excision was made, supplemented by radium and x-ray therapy. The carcinomatous involvement of the face and neck extended rapidly and death ensued. Suppuration and necrosis were extensive.

This case emphasizes the necessity of realizing that an osteomyelitis of infective origin does not cause an annular loss of bone such as was shown in the x-ray examination except in the later stages, when removal of sequestra from the lower border would result in a somewhat similar appearance of the roentgenogram.

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OSTEOPETROSIS: REPORT OF CASE

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MEDICAL literature affords little information on the disease process osteopetrosis. The rarity of reported cases makes this fact understandable.

The disease, known also as Albers-Schönberg disease, congenital osteosclerosis, osteosclerosis fragilis generalisata and "marble bones" (because of the uniformly white appearance of the bones in the roentgenogram), manifests itself primarily by an excessive calcification of osteoid tissue without true ossification. The cortex of the skeleton increases in size at the expense of the medullary portions; the result being a diversity of numerous secondary manifestations arising from the lack of bone lamellae and loss of the medulla of the osseous system.

Signs may be noted soon after birth or in middle life. However, in the majority of cases, the condition is diagnosed in early childhood or can be traced back to that period.

A search through the literature reveals few cases, but, in the essentials, they present characteristics of a common malady.

The etiology to date appears to be unknown. Heredity and inbreeding stand out as sole definite factors in the condition. The rarity of the ailment suggests a tendency to be recessive. There is no predilection for either sex. Endocrinologic studies have possibly thrown some light on the etiology, able investigators having reported a similar pathologic entity in the experimental animal from the administration of parathormone over long periods of time. However, there is no definite evidence to date that endocrine dysfunction has an etiologic rôle in the disease.

Multiple fracture of the long bones following relatively insignificant injury is a common finding. The increase in mineral content and the lack of bone lamellae diminish elasticity and increase susceptibility to fracture. There is usually no interference with healing.

Physical underdevelopment and deformities are not infrequently noted. The delayed appearance of the epiphyses and disturbance of endochondral ossification, which lead to softening of the epiphyseal lines, result in bony deformities. The stature is unaffected, the long bones usually attaining normal length. Thoracic deformities, scoliosis and coxa vara are most frequently described.

Descriptions of changes in the head are noteworthy. Many of the patients are hydrocephalic, but, aside from the characteristic head deformity seen in the latter, many observers describe a typical facial expression

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of osteopetrosis, a broad face, with eyes wide apart, and widely separated alar cartilages with the nares round and far apart. The hair is usually abundant. Prominence of the frontal bosses is also seen.

Imperfection of the dentition, chiefly in the form of delayed or incomplete eruption, is the rule. Poor tooth structure, rendering the teeth more liable to the onslaught of dental caries and subsequent dento-alveolar disease, readily lends itself to widespread suppurative destruction of the jaws, more commonly the mandible, and jaw necrosis is mentioned in most

Fig. 1.—Skull showing increase in thickness and sclerosis of base. The small pituitary fossa, unerupted teeth and diffuse sclerosis are to be noted in the mandible.

of the reported cases. The reduction in blood supply, plus the usually seen leukopenia, is carefully considered in this regard.

The loss of hematopoietic tissue results in the bizarre blood picture seen with bone marrow involvement, and the patient may become entirely dependent on extramedullary blood formation. Myelophthisic anemia is characteristic. Palpable lymph nodes with enlargement of the liver and spleen

have been interpreted by some observers as indicative of extramedullary hematopoiesis. Leukemic pictures have been reported as terminal states.

Neurologic findings continue to present the characteristic clinical picture. Deafness, paralysis of the extraocular motor muscles, nystagmus and signs of optic atrophy are attributed to increased narrowing of the bony foramina with consequent infringement upon the nerve and blood supply.

Regardless of an almost characteristic clinical picture, diagnosis during life is invariably made by the roentgenologist. The displacement of the medullary structure by the homogeneous, dense, compact cortex is the chief element in the disease process. Roentgenographically, conditions attributable to this abnormal calcification process are seen throughout the body.

Differentiation from other osteodystrophy should offer little difficulty. The commonest erroneous diagnosis appears to be rickets. Clinically, the conditions may simulate each other; roentgenographically, they differ widely. Chronic phosphorus poisoning with osteosclerosis and necrosis of the mandible has been known to present a differential diagnostic problem, but the history and more thorough clinical and roentgenologic investigation should readily clarify the situation.

The disease may be slowly progressive over many years or may progress rapidly and terminate fatally within a relatively short period. Death may occur *in utero*. In certain instances, progress of the disease appears to be arrested. One of the earliest reported cases was diagnosed at the age of 26 and, at 44, there was apparently no change in the progress of the disease. Usually, there is gradual mental and physical deterioration. Deafness, blindness, increasing suppuration and progressive downhill changes in the blood picture lead to a fatal end.

The only treatment lies in constantly guarding the patient, to prevent trauma and infection, and giving transfusions as necessary. Iron preparations to combat the anemia are of little value. Eugenic therapy is an important prophylactic.

REPORT OF CASE

History.—A woman, aged 25, a housewife, was admitted to the hospital complaining chiefly of pain, intra-oral discharge from the right mandible and a continuous discharge from beneath the left eye. She stated that her teeth had always been very poor and, several weeks after the removal of the right maxillary teeth, there was swelling in the right cheek which pointed to the infra-orbital area. Extra-oral incision and drainage were almost simultaneously accompanied by spontaneous rupture in the right maxillary mucobuccal fornix. Drainage from these sites persisted for nine months.

During this period, the left maxillary teeth were removed, after which there was an almost identical sequence of events. About five months before admission to hospital, it became necessary to remove the right mandibular teeth, and again there was extra-oral swelling, with exquisite tenderness, in the right body of the mandible accompanied by a subsequent foul intra-oral discharge.

The past history had some significance. As a child, the patient was never strong and was forced to restrict her activities. A diagnosis of rickets was made during childhood and dietary measures were instituted to correct this disorder. Her sight had always been poor and she did not believe that the vision was improved by the use of glasses.

The most noteworthy factor in the history was frequent fracture of the long bones as a result of relatively trivial injuries. The patient recalled fracture of the lower extremities as occurring at least three times.

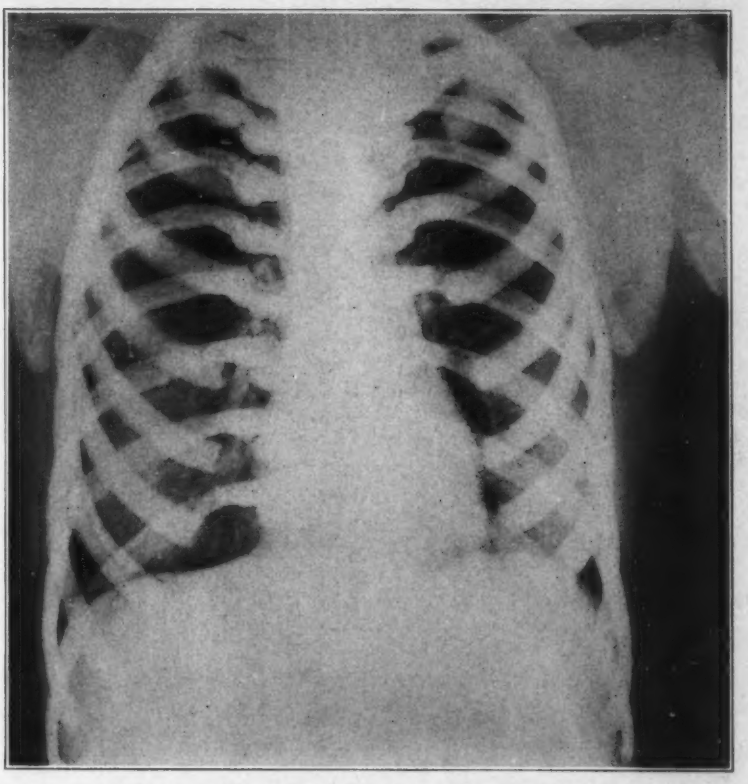

Fig. 2.—Chest, showing homogeneous whiteness of the ribs.

Menstruation had been entirely normal. The patient had been married seven years and had one child, aged 5, living and well. A second child died in infancy of pneumonia.

There were eight sisters and brothers, all living and well. The mother and father were both over 70 years and were relatively well. There was no definite evidence of familial disease or of inbreeding.

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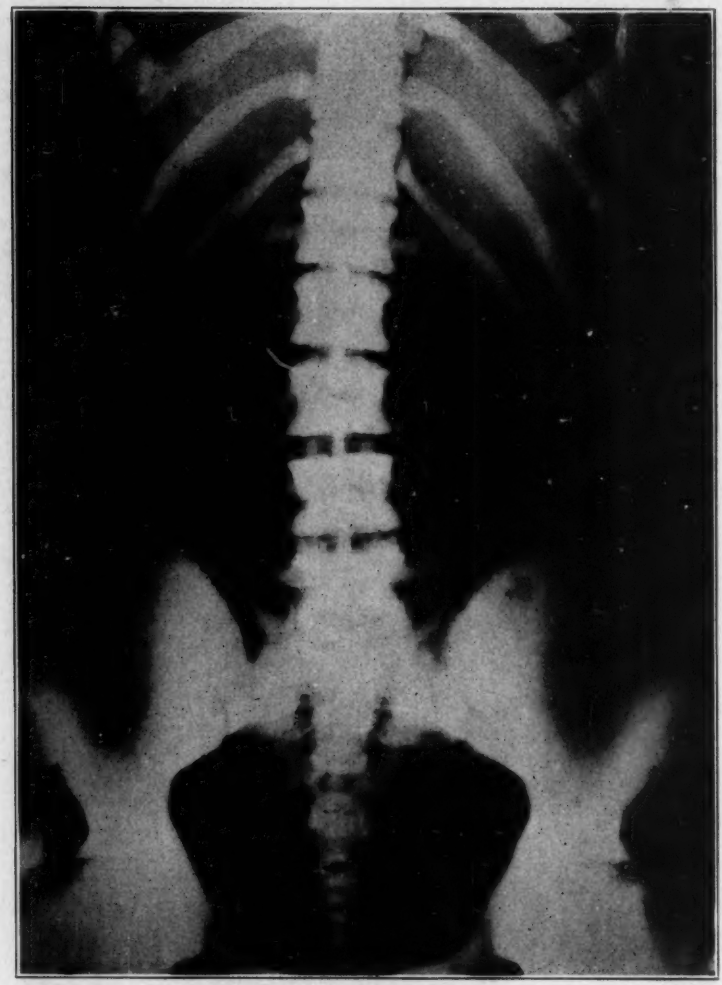

Fig. 3.—Inferior spine and pelvis. The densely sclerotic margins of the bodies and obliteration of the cancellous structure, with the exception of a small band in the middle third, are to be noted.

Physical Examination.—The patient was pale and poorly nourished, but did not appear acutely ill. She was cooperative, but evidenced a rather infantile reaction to her environment. The skin was pale and dry. The hair was abundant. The head was enlarged. The frontal bosses were prominent. The eyes were far apart. The extra-ocular movements were slightly impaired in all

directions. There was an alternating divergent strabismus, of from eight to ten degrees, with slow nystagmus in the primary position. The pupils reacted sluggishly to light and in accommodation. Examination of the ocular fundi revealed small disks, well-outlined, grayish white, with decreased capillarity. The maculae were granular.

A linear depressed scar was seen in the right infra-orbital area. From a sinus orifice in the left infra-orbital area, an abundance of foul purulent fluid could be readily expressed.

There was an ill-defined inflammatory swelling over the right body of the mandible extending downward to the submaxillary area. Intra-oral examination revealed the absence of almost the entire dentition. There were extensive bilateral oral-antral communications in the mucobuccal fornices. The left antrum was filled with a thick grayish purulent material. The right mandibular alveolar process was exposed, necrotic and covered with a purulent fluid.

Cervical lymphadenopathy was not apparent. Clinical examination of the chest was not remarkable. The spleen was easily palpable three or four finger-breadths below the left costal margin when the abdomen was relaxed.

Examination of the extremities revealed that all bones were thickened and roughened. There were fusiform swellings at the distal ends of the femora and tibiae.

The deep tendon reflexes were equally hyperactive. Motor function was normal.

Blood studies upon admission revealed the following: red blood cells, 2,900,000; white blood cells, 4,100; hemoglobin, 42 per cent (6.6 gm.); differential count: polymorphonuclear neutrophils, 64 per cent; large lymphocytes, 23 per cent; small lymphocytes, 6 per cent; monocytes, 6 per cent; eosinophils, 1 per cent; basophils 0. The platelets were normal in number. The hematocrit reading was 23; mean corpuscular volume, 79. The red blood cells showed marked anisocytosis and poikilocytosis. The reticulocytes were markedly increased and nucleated red cells were present. The white blood cells showed two plus toxic granulations. The blood pictures during the successive few months were almost identical.

The blood serum inorganic phosphorus was determined to be 4.3 mg. and calcium 9.8 mg. per hundred cubic centimeters, and phosphatase 4.1 Bodansky units.

The roentgenographic changes were most significant. All bones of the entire skeleton were found to be unusually dense. It was further noted that the overgrowth of bone was not characteristic of a periostitis, but proliferation from the endosteum, and, in virtually all long bones, there was evident reduction of the medullary space.

The flat bones of the cranial vault were increased in thickness and density. In addition, all structures at the base of the skull showed an increase in thickness and in sclerosis. The pituitary fossa was very small. In oblique projection, each optic foramen was found to be diminished in size owing to an increase in thickness of the surrounding bone in each lesser wing of the sphenoid. The caliber of the internal auditory canals was slightly reduced.

The paranasal sinuses were very small and there was very little pneumatization of the mastoids.

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Examination of the mandible revealed diffuse sclerosis and overgrowth of bone. The remaining teeth were irregularly placed, and multiple unerupted teeth were seen.

In the spine, dense sclerotic margins extended in from the articular surfaces of the bodies to apparently obliterate all the cancellous area with the exception of a small band in the middle third. The accessory processes were unusually dense. The ribs were homogeneous in whiteness.

The shape of the pelvis was altered. There was bilateral coxa vara, which appeared to have developed as a result of fracture through the base of each femoral neck. The deformity was greater on the left. The lower half of each femoral shaft was definitely broadened and had a clubbed appearance.

The diagnosis was: 1. Osteopetrosis. 2. Myelophthisic anemia. 3. Chronic osteomyelitis of the maxilla and mandible. 4. Optic atrophy. 5. Alternating divergent strabismus. 6. Multiple healed fracture of the long bones.

Course.—The hospital course and immediate postdischarge period were remarkably uneventful. An abscess in the right mandibular space required incision and drainage and there was evidence of direct extension of the necrotic process of the mandible to beyond the midline. There was no evidence of sequestration.

The blood picture has remained constant despite intensive iron therapy.

SUMMARY

The principal characteristic of osteopetrosis is a generalized displacement of the medullary portion of the bones by dense, compact cortical bone, with resultant numerous secondary manifestations arising from the loss of the medulla of the osseous system. The etiology is unknown and therapy is confined to symptomatic treatment. This case has oral surgical significance in view of the fact that diagnosis was based on signs and symptoms that developed from dental disease.

Imperturbability.—In the physician or surgeon no quality takes rank with imperturbability, and I propose for a few minutes to direct your attention to this essential bodily virtue. Perhaps I may be able to give those of you in whom it has not developed . . . a hint or two of its importance, possibly a suggestion for its attainment. Imperturbability means coolness and presence of mind under all circumstances, calmness amid storm, clearness of judgment in moments of grave peril, immobility, impassiveness, or, to use an old and expressive word, phlegm. It is the quality which is most appreciated by the laity though often misunderstood by them; and the physician who has the misfortune to be without it, who betrays indecision and worry, and who shows that he is flustered and flurried in ordinary emergencies, loses rapidly the confidence of his patients. In full development, as we see it in some of our older colleagues, it has the nature of a divine gift, a blessing to the possessor, a comfort to all who come in contact with him.—Osler.

ADENOCARCINOMA ORIGINATING FROM ABERRANT TISSUE IN THE GINGIVA: REPORT OF A CASE

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THE gingivae are composed of a firm tissue which covers the alveolar borders of the maxilla and mandible and surrounds the neck of the teeth. In structure, they consist of dense fibrous tissue inseparably united to the periosteum, covered by mucous membrane. They are richly supplied with blood vessels, but sparsely with nerves and are covered by stratified squamous epithelium.[1] Since no glandular epithelium covers the surface of the gingivae, the carcinoma must perforce have originated either in aberrant glandular tissue located in the gingiva, or by extension from glandular tissue covering nearby structures, the nearest being the maxillary sinus. In the case reported herewith, the roentgenologist thought that the sinus appeared, in the x-ray film, to be a neoplasm. This assumption is incorrect since, at operation, the sinus was found to be free from carcinomatous growth. One may conjecture that buccal mucosa may have been transplanted to the gingiva by the dentist while doing some dental work. This is possible, but not probable.

The frequency with which tumors develop in aberrant tissue in comparison with normally located tissues has not been computed; nor can it be computed since we are not aware of all the aberrant tissue present in the body. A complete histologic survey of numerous bodies would be necessary to determine, first, the relative frequency of development of aberrant tissues and then to estimate the number of tumors occurring in them as compared with the number occurring in tissues normally located. Tumors of aberrant tissue have been reported, particularly of the adrenals and aberrant thyroids.

MacMillan and Gilbert[2] reported a hypernephroma of aberrant adrenal tissue found in the omentum.

Ho Kwan Heen[3] reported a case of carcinoma of a lateral aberrant thyroid.

Ward[4] analyzed fifteen cases of tumors of aberrant thyroid tissue. He found twelve of these growths to be malignant and three benign.

REPORT OF CASE

History.—L. L., a woman, aged 32, married and the mother of one child, was referred by Drs. Harris and Bloom, with a history of a painful swelling on the left upper jaw in the region of the molars, first noted six years before. A dentist advised the extraction of certain teeth, but after the teeth were

From the service of Dr. Loeb at the Bronx Hospital.

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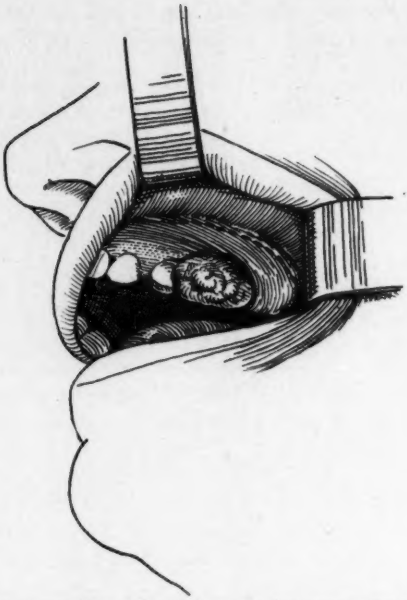

Fig. 1.—Appearance of growth on gingiva over molar region.

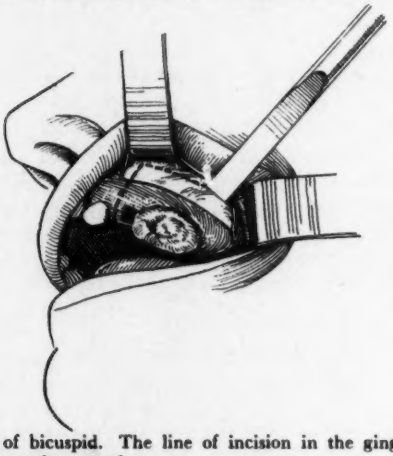

Fig. 2.—Removal of bicuspid. The line of incision in the gingiva outlines the area that was chiseled away and removed.

extracted, the patient still suffered from the same symptoms. She returned again to the dentist, who diagnosed her case as periostitis secondary to the extraction, and scraped the bone. After this, she improved, but complained of

intermittent pains starting in the left maxilla and radiating to the left side of the forehead and occasionally to the left side of the neck. At no time did the patient have any fever or discharge.

Physical Examination.—The physical examination was negative except for general weakness, of which the patient had complained for the past year.

Examination of the mouth revealed a growth on the left gingiva in the region of the molars. (Fig. 1.) This growth extended backward and inward over the hard palate. The face on the side of the growth was markedly swollen. Tenderness was elicited both on the cheek and on the gum. Because of the long duration of this condition, the diagnosis of a non-malignant epulis was made.

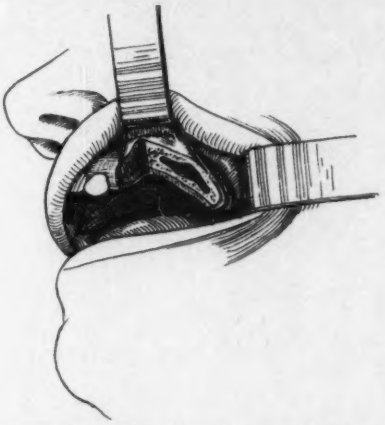

Fig. 3.—Growth excised. The antrum of Highmore was cut across in the line of excision and its opening is visible on the plate.

However, biopsy of a specimen taken from the gum showed it to be an adenocarcinomatous growth.

X-ray examination of the paranasal sinuses and of the left upper jaw showed a cystic formation of the bone in the region of the floor of the antrum and extending to the alveolar process. The appearance was that of a neoplasm. The x-ray films had been disposed of and, for this reason, no photograph of the film is shown.

Laboratory findings on the blood and urine were negative.

Operation.—August 1, 1937, under tribromethyl alcohol anesthesia, the mucous membrane of the left gingival-labial angle was incised from the posterior surface of the alveolar process of the upper maxilla to the junction with its fellow of the opposite side. (Fig. 2.) The cheek was separated from the underlying maxilla and retracted upward. A premolar tooth was removed. With a chisel directed upward from its lower border, a little to the left of the midline, the alveolar process was cut across from below upward to the level of the anterior nasal spine. The alveolar process was then cut across horizontally from a little to the left of the midline, to the left posterior border of the alveolar

process. With the bony mass held in a bone forceps and pried open, the hard palate, including part of the maxillary sinus, was cut across from before backwards. Any spicules of bone, wherever the mass to be removed was still attached by them, were chiseled across. (Fig. 2.) The mass was then removed. This brought into view the cavity of the antrum (Fig. 3), which showed no carcinomatous involvement. Bleeding, which was profuse, was checked by packing the maxillary sinus and the wound. There were no important nerves involved in the excision. The cut surface of the bone, which included the base

Fig. 4.—Microscopic section consisting almost entirely of neoplastic glandular structures lined with high columnar epithelium and varying considerably in size and shape. Many of the glands are filled with a mucinous-like secretion. In some areas, the connective tissue stroma is exceedingly sparse, while, in others, a considerable amount is present, and is moderately vascular. The general features are those of an adenocarcinoma, Grade II, probably springing either from the sinus epithelium or oral glandular structures.

of the sinus, was examined carefully and found to be free from carcinomatous growth. The carcinoma was found to be encapsulated, lying within the layers

of the gingiva and growing into the bone structure. The growth evidently did not originate in the sinus.

Postoperative Course.—The packing from the antrum and the wound was removed on the third day and the antrum and wound were irrigated with saline solution at frequent intervals. On the third day, the patient was able to eat and had no trouble in swallowing. Several weeks passed before granulation and healing were complete. At the present time, six years after the operation, the patient is perfectly well. She is using with a great deal of comfort a prosthetic appliance made for her. A small opening from the antrum connects with the cavity of the mouth. This is just large enough for a probe to enter. Occasionally, the antrum becomes infected and it is then irrigated through a sawed-off number 18 needle and the pus aspirated. After one of these treatments, the patient is usually well for a period of from six to eight months.

After the operation, the patient was given a course of x-ray therapy.

Pathology (Report by Dr. Felsen).—The specimen consisted of an irregular piece of bony tissue measuring 4 by 3 cm. and covered by gum tissue. Upon section, the bony portion was found to be friable. A firm white homogeneous mass infiltrated its substance.

Microscopic Diagnosis (Fig. 4).—The section consisted almost entirely of neoplastic glandular structures lined by high columnar epithelium and varying considerably in size and shape. Many of the glands were filled with a mucinous-like secretion. In some areas, the connective tissue stroma was exceedingly sparse; in others, a considerable amount, moderately vascular, was present. The general features were those of an adenocarcinoma, Grade II, probably springing from either the sinus epithelium or the oral glandular structures.

CONCLUSION

In a case of adenocarcinoma originating in aberrant tissue located in the gums and growing into the bone structure, a comparatively simple operation followed by x-ray therapy resulted, thus far, in a six-year cure. Since the entire operation was performed from within the oral cavity, there were no skin scars and no interference with the facial configuration.

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1882 Grand Concourse.

CLEIDOCRANIAL DYSOSTOSIS: REPORT OF TWO CASES

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IT is not unusual for rare aberrations of the bony system to manifest multiple and varied dental changes. Most recently, in 1943, an exhaustive study of the dental conditions in cleidocranial dysostosis has been presented by Winter.[1] Prior to this work, Anspach and Huepel,[2] in 1939, discussed the developmental and oral changes associated with the marked and characteristic aplasia of the clavicle in this syndrome. These ossification defects of the clavicle, which are congenital, are associated with imperfect ossification of the cranial and facial bones.

Cleidocranial dysostosis is a rare disease. And, in view of its rarity (at present, only 250 cases have been reported), it is thought desirable to augment the literature with these two cases. It is striking to note that both these patients were encountered within a six months interval; the first, at the Aberdeen Proving Ground, Maryland; the second, at Camp Sibert, Alabama. Of course, the numerous routine examinations in military medicine and dentistry actually lengthen this time interval.

This syndrome, described as early as 1760, was first named by Marie and Sainton[3] in 1897 as hereditary cleidocranial dysostosis. Four leading features of the disease are mentioned by these early workers: (1) aplasia, more or less marked, of one or both clavicles; (2) exaggerated development of the transverse diameter of the cranium; (3) delay in ossification of the fontanels, and (4) hereditary transmission. These features are variable according to the cases reported except for the constancy of the clavicular deformity.

The clavicular defect permits the affected shoulder to be brought well in front of the patient. When both clavicles are involved, both shoulders can be brought downward and medially until they touch each other. The delay in closure of the sutures and fontanels of the cranium results in the formation of bosses corresponding to the frontal, parietal and occipital bones, as characterized by the large brachycephalic heads of these patients. Some of the accompanying physical findings are smallness of stature, shrinking of facial bones, depression of the bridge of the nose and prognathism of the lower jaw.

The oral findings are unique and fairly constant. Marked retardation of development of the teeth, along with the presence of a high vaulted, often grooved or cleft palate, seems to be a consistent feature whenever the dentition is considered by these investigators. Anodontia, defects of the

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Fig. 1 (Case 1).—Cranial characteristics.

Fig. 2 (Case 1).—Clavicular defect giving appearance of two bony parts joined by radiolucent tissue.

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enamel, a high caries index, a multiplicity of retained deciduous and supernumerary teeth, extreme and unusual root formations and dentigerous cysts have all been reported. Fitchet,[4] in 1929, and Cooper,[5] in 1938, particularly emphasized the delayed exfoliation of the deciduous teeth and faulty eruption of the permanent dentition.

These dental findings may be consistent with rickets, craniofacial dysostosis, or achondroplasia. The specificity of cleidocranial dysostosis lies, of course, in the faulty ossification of the clavicles. Although cleidocranial

Fig. 3 (Case 1).—Lateral jaw roentgenogram emphasizing overdevelopment of mandible and impaction of permanent bicuspids.

dysostosis may be overlooked at a physical examination, the unique dental dystrophy may contribute toward a diagnosis.

The etiology of this disease is highly problematical. Although no specific cause has as yet been promulgated, there is a strong conviction that the condition is embryologic and hereditary. The presence of amniotic bands or intra-uterine muscular convulsions of the fetus, as well as insufficiency of the germ plasm, has also been suspected. It is probable that any mechanism explaining the syndrome may be a critical factor in the interpretation of prolonged retention of deciduous teeth.

REPORT OF CASES

CASE 1.—*History.*—A man, white, aged 25, a soldier, came to the dental clinic at the Aberdeen Proving Ground, Maryland, August 8, 1942, requesting dental care. He stated that he was unable to get enough nourishment from

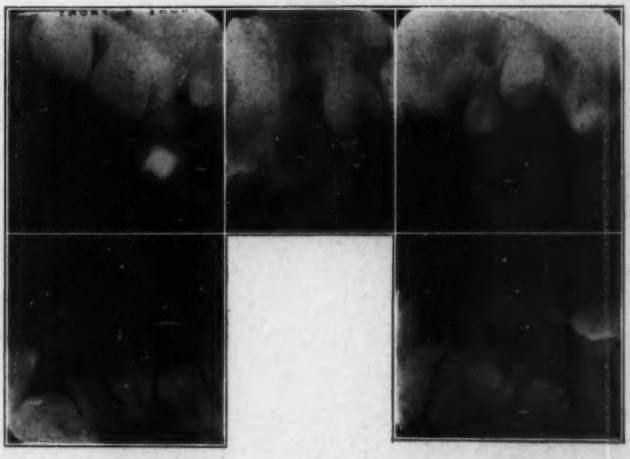

Fig. 4 (Case 1).—Multiplicity of retained deciduous, impacted permanent and supernumerary teeth.

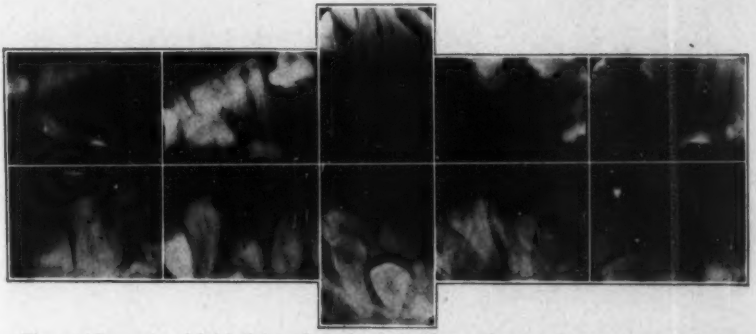

Fig. 5 (Case 2).—Multiplicity of retained deciduous, impacted permanent and supernumerary teeth.

any food. At home, he felt that he could get sufficient milk and fruit to maintain his diet.

The history indicated that birth and early development had been essentially normal. At the age of 4, the patient fell out of bed and, at this time, his mother noticed a swelling over the right clavicle. Recovery from the fall was uneventful

ful. The patient attended school and was graduated from a high school vocational course at 17 years of age.

His first teeth erupted promptly. They were described as "big and heavy" and had to be extracted when he was 12 years of age. At the time of examination, he had six maxillary and nine mandibular teeth, of which only two were in occlusion.

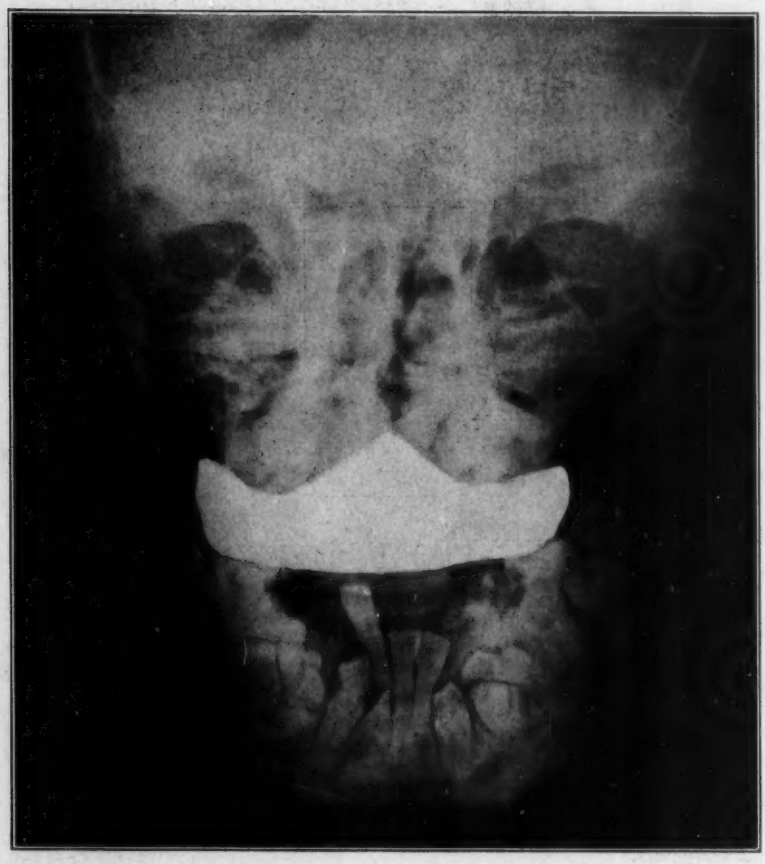

Fig. 6 (Case 2).—Postero-anterior roentgenogram showing numerous impacted and supernumerary teeth in mandible. The upper denture is in place.

After the usual childhood diseases, the patient had enjoyed good health. The family history was negative. The patient stated that he was the second oldest child and that no others in the family had abnormalities.

Examination.—The physical examination was essentially negative. The

height was 64½ inches, weight 137 pounds. The skin was normal. Examination of the skull indicated that the cranium was large in proportion to the face. The frontal and parietal eminences were prominent. The maxilla was small. The hard palate was deeply grooved and nearly cleft across the midline. The lower jaw was prognathous. The muscles of the neck were thick and the thorax was well developed.

The lungs, heart and vascular system were negative. The muscular system was normal and adequate. With little difficulty, the right shoulder could be brought medially to touch the chest.

Roentgenologic Report.—Cleidocranial dysostosis was diagnosed. The examination of the skull and also of the axial skeleton presented a textbook picture of this rather rare condition, which is usually hereditary. The cranium was

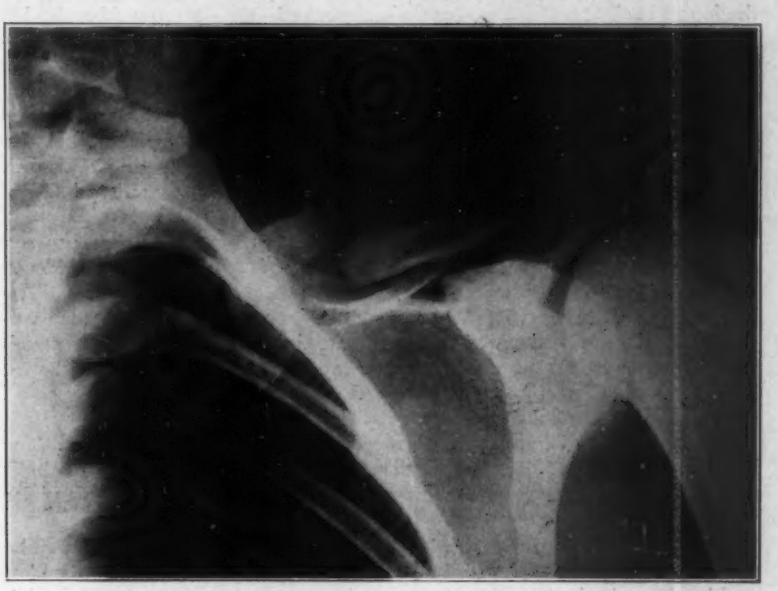

Fig. 7 (Case 2).—Clavicular defect.

out of proportion to the face. The suture lines were widened and the cranial bones ossified from a multitude of centers giving an appearance of many wormian bones. Many of the teeth, particularly those in the upper jaw, failed to erupt. The thorax had a conical shape and the clavicles showed maldevelopment. In the present case, the midportion of the right clavicle failed to develop. The pelvis was deficient and the ilium was narrow and of peculiar shape. Examination of the mandible revealed several unerupted teeth. The right third molar was partially erupted. The second right bicuspid and the cuspid were unerupted. On the left, the second molar was missing

and the second bicuspid unerupted. In the upper jaw, several teeth were unerupted. There was no evidence of infection or tumor.

CASE 2.—*History.*—A man, white, aged 21, a soldier, reported March 30, 1943, to the dental clinic at Camp Sibert, Alabama, for emergency treatment. Attention was drawn to the fact that, despite the presence of a complete upper denture, there were several partially erupted maxillary teeth present. Numerous erupting cusps of teeth were also visible on the mandibular ridge.

On questioning, the patient stated that the deciduous teeth were loosened and fell out at 12 years of age, but the permanent teeth did not erupt. He also stated that he was underweight and, on the advice of a dentist, took cod liver oil for one and one-half years. This increased his weight and strength, but had no effect on his teeth. He added that he always had a weakness of the knees, back and shoulder, but normal strength in his arms and hands. He commented that the upper denture was made in an effort to cause the permanent teeth to erupt and as a masticatory aid, but without success.

There was an uneventful history of the usual childhood diseases and no indications of tuberculosis, cancer or epilepsy. The patient's occupation prior to induction into the army was that of a tool hustler in an airplane plant. He stated that he was a moderate cigaret smoker and rarely drank alcohol. Both parents and an only brother were living and well. The patient had finished high school when 18 years of age.

Aside from his dental ailments, his chief difficulty was an inability to run or walk great distances because of weakness of the knees, back and shoulders.

Examination.—The physical examination was essentially negative. The height was 70½ inches, weight 142 pounds. There was a moderate acne vulgaris. The skull showed a moderate bulging of the frontal bones. The fontanels were closed and there were raised ridges over the ears on the parietal bones. The maxilla was small, very narrow and V-shaped, with a distinct grooved furrow across the middle of the palate. The lower jaw was prognathous.

The pharynx and lungs were clear and the thorax slightly concave. The blood pressure was 108 systolic, 68 diastolic, and the heart beat was rhythmic and there were no murmurs. The abdomen, genito-urinary and glandular systems were essentially negative.

The clavicle appeared to be in two parts joined by fibrous tissue. The scapulae were winged with very low, flattened spinous processes. The shoulders could voluntarily be brought to meet each other upon the chest. The pelvis seemed to be small and narrow in the transverse direction.

While there was noted a sluggish reaction of the eyes to light and an increase of the knee jerk, the Romberg sign was negative and the coordination good.

Roentgenographic Examination.—The cranium was hydrocephalic, with marked occipital, parietal and frontal bosses. There were multiple, almost triple coronal sutures and double lambdoidal sutures forming numerous wormian bones. There was a moderate prognathism.

The cervical spine was rather poorly developed and calcified, with spina bifida of cervical vertebra VI. There was evidently a congenital defect of the acromial ends and the midportions of both clavicles.

Both lesser multiangular bones appeared rather small. Both fourth metacarpals were rather slight. Both second metacarpals were overdeveloped, being very long. The phalanges were essentially normal, except for the absence of flaring in all distal phalanges. Instead, these phalanges appeared conical, with straight, blunt ends.

The rest of the skeleton was essentially negative.

The condition was believed to be a cleidocranial dysostosis.

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Modern Anesthesiology and the Anesthetist.—The anesthetist should be familiar with the use of a direct laryngoscope, either for the passing of an endotracheal catheter or the inspection of the larynx and vocal cords. In fact, no matter how much the trachea is deviated or narrowed, he should be capable of introducing an endotracheal catheter either by the direct route or by one of the so-called "blind" methods of intubation. He should recognize the importance of keeping the tracheobronchial tree free of secretions and other fluid, and should be prepared and able to remove these secretions before operation, during operation, and after operation; in other words, he should be familiar with the technique of bronchoscopy, and should be able to recognize when this procedure is indicated. He should be capable of maintaining constant, positive pressure anesthesia when indicated and of maintaining artificial respiration when, for any reason, such as an overdose of an anesthetic agent, or when the spinal anesthesia has inadvertently gone too high, the patient is unable to maintain his own respiration.—Frank H. Lahey, in *Surg., Gynec. & Obst.*, September 1943.

UMI

CARCINOMA OF THE INDIFFERENT CELL TYPE INVOLVING THE MAXILLAE: REPORT OF A CASE

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THIS report is of interest because of the youth of the patient, the benign appearance of the lesion and the difficulty in correlating the microscopic appearance of the growth with the clinical findings.

REPORT OF CASE

History.—A woman, aged 25, married, was seen by her dentist in 1939 because of a "lump" located in the right maxillary canine region. An impacted tooth was provisionally suspected, but a roentgenogram failed to reveal its presence or any unusual changes in the alveolar bone. The roentgenogram was not seen by us. The mandibular right second premolar and first molar were extracted by the patient's dentist in 1940, when the two teeth came out together, owing to a true fusion. The remaining teeth in the right maxillary canine region (second incisor and canine) were extracted March 15, 1943 by the same dentist. An alveolectomy was then performed in the area of the canine to reduce the "lump" sufficiently to permit the proper fitting of a denture. The osseous tissue removed at this time was hard and brittle, but had the "feel" of normal bone. These findings were reported to us by the attending dentist. The roentgenogram taken before his operative intervention was not available to us when the patient was brought in for consultation. The site of operation failed to heal readily. The patient was referred to the School of Dentistry of the University of Pennsylvania April 13, 1943 for further diagnosis and treatment. The past medical and family history was irrelevant.

Examination.—The patient was moderately developed, but rather thin and underweight. The Wassermann reaction was negative. Other laboratory studies revealed nothing except a moderate anemia. Examination of the mouth revealed edentulous maxillae and seven teeth present in the mandible. There was evidence of recent extractions in the mandibular incisor region. No abnormalities were observed on the buccal mucosa, the gingivae and the tongue except a lesion that occupied an area in the right maxillary canine and second incisor region, extending from the first incisor to the first premolar, and from the mucobuccal fold to a small area on the palatal surface of the ridge. It was

From the School of Dentistry, University of Pennsylvania and the American Oncologic Hospital.

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‡Professor of oral pathology, School of Dentistry, University of Pennsylvania, and consulting pathologist, American Oncologic Hospital.

covered with a mucosa which appeared normal, except over the summit of the ridge, where the tissue was darker than normal. The labial surface was slightly edematous and a fissure separated it from the hard bony outgrowth on the palatal surface of the ridge. (Fig. 1.) The patient did not complain of pain. There was no evidence of ulceration and bleeding, of palpable cervical or submaxillary lymph nodes or other signs of metastasis.

Roentgenologic Examination.—An occlusal film of the maxillae revealed a

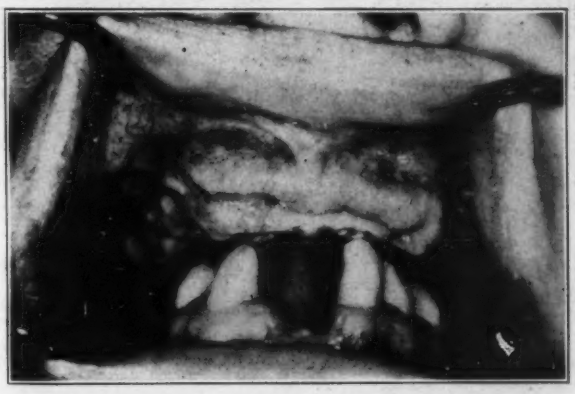

Fig. 1.—Clinical appearance of apparently benign lesion, which proved to be carcinoma of indifferent cell type.

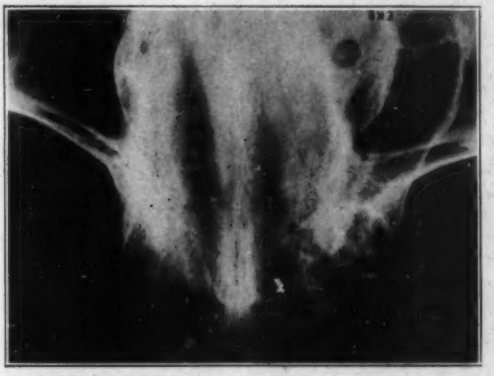

Fig. 2.—Occlusal roentgenogram revealing radiolucent area which suggested some malignant condition. (L. M. Ennis.)

radiolucent area, extending from the region of the right first incisor to the right first premolar (Fig. 2), which suggested some malignant condition. (L. M. Ennis.) The patient was referred to the Surgery Department, where a biopsy specimen was secured from the involved area by one of us (J. H. G.). When

the specimen was removed, April 15, 1943, the tissue was found very spongy. It was readily removed with a chisel and hand pressure, but the bony consistency was not normal. The area from which the biopsy specimen was removed April 26 appeared malignant. (Fig. 3.) The lesion, which was slow in healing, extended from the right maxillary first incisor to the right first pre-

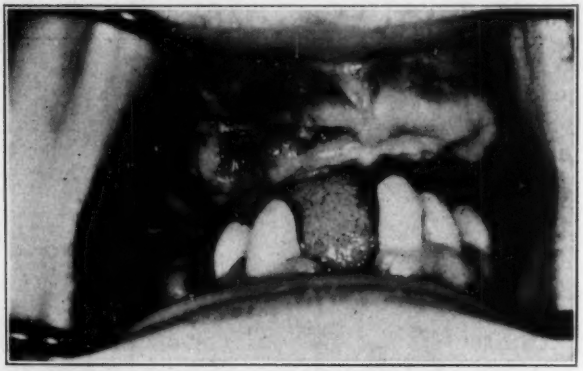

Fig. 3.—Appearance of case eleven days later. The area from which the biopsy specimen was removed appears malignant.

Fig. 4.—Wound completely epithelialized, two months after operation. Antral and nasal openings can be seen. The area is ready for a prosthetic restoration.

molar. The mucosa covering the labial and palatal aspects of the lesion was now fiery red, and the tissue covering the destroyed alveolar ridge was myxomatous in appearance.

*Pathologic Findings.**—The tumor presented diverse pictures, all in greater or less degree characteristic of a different tumor. There was evidence suggestive of a basal cell carcinoma. Other evidence suggested osteitis fibrosa, noncystic, a squamous cell carcinoma or a tumor of neurogenic origin. In certain areas, the detail of the parenchyma might have led one to think of an odontogenetic tumor.

The cells of this carcinoma were polymorphous, of a squamous, columnar, spindle and stellate type. Some of these cells were decidedly vesicular, with

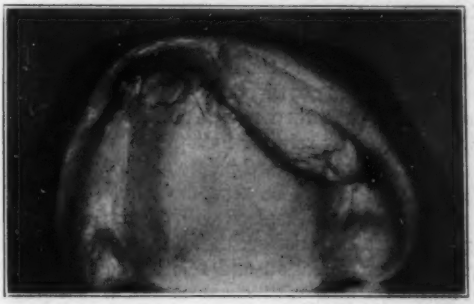

Fig. 5.—Palatal surface of maxillary denture, showing overextension necessary to restore facial contour.

Fig. 6.—Full maxillary and partial mandibular dentures in occlusion.

hyperchromatic nuclei. The presence of this slow-growing tumor near the bone led to destruction of the alveolar ridge. The slow growth allowed osteoblastic activity. The inflammatory nature of the parenchyma and its vascularity may have accounted for the pseudomyxomatous features encountered here and

*A detailed discussion of the unusual pathologic features of this tumor will be presented in a separate paper by H. R. Churchill, oral pathologist, School of Dentistry, University of Pennsylvania.

there. Deep infiltration, hyperchromatism and the peculiar irregularity of the cells suggested a diagnosis of carcinoma of the indifferent type.

The fact that few mitotic figures were present corresponds apparently with the fact that the tumor was of four years' duration. The absence of anaplasia rendered the grade of malignancy relatively low. The prognosis was good, notwithstanding the fact that the prognosis of carcinoma in young people is usually unfavorable.

Treatment.—One of us (J. H. G.) performed a partial resection of the right maxilla May 4, under general anesthesia (vinethene induction followed by ethyl-ether by insufflation.)

An elliptical incision was made well beyond the tumor mass, extending from the left maxillary second incisor to the right maxillary first molar, and well onto the hard palate. The segment outlined was removed *en masse* with chisel and mallet. The soft tissues were then reflected with a broad periosteal elevator and the bone was removed by rongeur forceps up to and including the floor of the nose, the anterior part of the hard palate and lower portion of the anterior wall of the maxillary sinus with its mucosa. The wound was finally packed with sulfanilamide gauze, held in place with black silk sutures. This packing was removed gradually after one week. The wound was completely epithelialized two months after operation and relative comfort was maintained by "plugging" the antral opening with clean cotton, which was changed by the patient several times a day. (Fig. 4.)

At a conference with the staff at the American Oncologic Hospital July 28, a prosthetic restoration was suggested. The patient was then referred to the Department of Surgical Prosthesis of the University, where a modified obturator was constructed for the maxillae and a partial denture fitted for the mandible. The prosthetic appliances were completed October 2, 1943. (Figs. 5 and 6.) The patient was completely satisfied with her appearance. Before her dismissal, she was placed on the follow-up system at the American Oncologic Hospital. She will be recalled for observation every month, and the time interval will be extended, depending on the opinion of the clinical conference. These patients are never discharged as cured.

Discussion.—The patient was presented at the conference of the Tumor Clinic held at the American Oncologic Hospital in Philadelphia, on April 28. From the clinical appearance, the lesion was diagnosed by many as a localized osteitis fibrosa. The radiolucent area revealed in the roentgenogram suggested malignant destruction of bone.

Microscopically, the lesion could be classified as a blastoma—a tumor consisting of one tissue, namely epithelial. The depth of infiltration of this tissue was further proof that here was malignancy of an epithelial nature, namely, carcinoma.

In the areas where the parenchyma led one to think of an odontogenetic tumor, it might well be considered as a tumor arising from the epithelial rests of Malassez. If the carcinoma had originated from the surface epithelium, it would be squamous-celled and not of odontogenetic origin.

The consensus of opinion favored immediate radical surgical intervention without irradiation.

SUMMARY

An apparently benign lesion in the right maxillary cuspid region in a young woman proved to be a carcinoma of the indifferent cell type. This case, which might have come to any dentist's attention, emphasized (1) the importance of studying a roentgenogram, properly taken prior to surgical intervention, and (2) the desirability of removing a portion of every suspicious lesion for microscopic examination. The difficulty of correlating the microscopic picture with the four years' duration of the growth marks this as an unusual case of a lesion which, when adequately treated early, usually has a favorable prognosis.

Modern Anesthesiology and the Anesthetist.—The anesthetist should have a fundamental knowledge of pharmacology and physiology; he should be able to induce expertly all types of anesthesia; he should, of course, be familiar with the newer agents and the methods of their administration, as, for instance, the induction of fractional (continuous) spinal anesthesia and anesthesia by means of the intravenous injection of the barbiturates. However, he should not neglect the older but still valuable agents and methods; it is still very important that the anesthetist be expert in inducing ether anesthesia and that he be able to recognize in a given case the value as well as the limitations of the use of nitrous oxide gas anesthesia, particularly with reference to the immediate and remote effects of anoxia. He should be able and be permitted to exercise judgment in the selection of the anesthetic agent and method he considers best adapted to the patient and the proposed operation. —Frank H. Lahey, in *Surg., Gynec. & Obst.*, September 1943.

RESTRAINING OF PATIENTS FOR GENERAL ANESTHESIA IN DENTAL OR SURGICAL CHAIRS

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OPERATIONS in regions of the mouth, face and head under general anesthesia are usually difficult if patients are not properly restrained. Procedures of a few minutes' duration are often completed with no interruption from the patient, but in longer procedures invariably difficulties are encountered which require special attention and definite restraint of the patient.

The behavior of patients, partially or totally anesthetized, may be dependent on (1) the type of surgical procedure, (2) the time required for operation, (3) the physical condition of the patient, (4) the time element of emergency, (5) the preparation of the patient, (6) the kind of anesthetic to be used and (7) the duration of the anesthesia, each of which is a factor in surgical procedure.

Salient factors in anesthesia for all surgical operations are blood pressure, pulse, respiration and position of the patient. (Many other factors are, of course, acknowledged, but they are irrelevant here.) Ill-effects from mechanical interference or obstruction of these physiologic functions may be injurious or even dangerous to the patient. It is important to consider this in restraining patients for procedures in operating chairs.

Patients who are supine or prone on a regular operating table are quite easily restrained, but those in sitting positions in operating chairs are more difficult to handle. Here, control of hands and feet, and slipping or sliding, are the major problems. Certain types of cranial and the majority of dental and oral surgical operations are performed in regular or slightly modified dental chairs, with the patient in a sitting position.

Major surgical procedures about the head and mouth, under general anesthesia, should be carried out with proper restraint of the patient. Often, short minor operations can be performed without restraining the patient, but many requiring more time invariably offer difficulties, owing to the patient's unfavorable physical behavior. Nitrous oxide anesthesia in dental surgery perhaps more consistently causes difficulty. Controlling the patient who does get unruly or otherwise assumes an unfavorable position is a problem, and provision for prevention or control should, if possible, be made before the anesthesia is begun.

In the administration of gas-oxygen and ether or vinethene, the methods shown in Figures 1, 2 and 3 are satisfactory. For intravenous pentothal

Fig. 1.—Method of restraining patient, showing main body strap of soft webbing material to which are attached straps encircling wrists and locking with snap buttons to restrain hands and afix body in chair, thus preventing sliding or other forward movement. Proper adjustment of these straps causes no discomfort to the patient and does not interfere with the respiratory function. The accessory knee strap shown is fastened to a small strap extending from beneath the cushion of the chair, but is seldom used. It is valuable for control of the legs in some cases. This is a satisfactory method, particularly for nitrous oxide-oxygen anesthesia in oral surgery and in exodontia.

Fig. 2.—Closeups of construction details showing principles of application of main wrist and body strap. This unit controls the hands and prevents forward slipping or movement of the body. For dental or oral surgery, the strap lies over the hands, compressing them against the abdomen. For cranial operations, the strap is turned upside down, allowing the hands to be above the main strap and to be free from compression or obstruction of the veins so that, in case intravenous fluids are necessary, there will be no interference, as seen in Figure 3.

sodium anesthesia, the methods shown in Figures 4 and 5 have proved satisfactory.

The method shown in Figure 6 has been effective in controlling patients

awakening from anesthesia or otherwise uncontrollable, in certain types of cases.

Patients, with few exceptions, should be sufficiently restrained for the specific case or procedure. No restraining devices or methods should be used which will interfere with respiration or cause obstruction of blood vessels.

I have tried many methods of restraining patients for general anesthesia in dental, oral and major surgical operations, particularly patients in a sitting position in dental or surgical chairs. Sometimes, makeshift methods were used by wrapping sheets and bands around the patient's body, arms and legs, for restraining purposes, but these were not always satisfactory.

Fig. 3.—Method for restraining patients for cranial surgery. The hands are positioned loosely over the body strap and are readily accessible for intravenous injections if necessary. The double knee strap, which is adjustable, fastens behind the chair. This, together with the body strap, affords total skeletal control in this type of operation. Additional padding is inserted under binding straps and a thin pillow is placed between the knees of the surgical patient in the operating rooms. (Method used at University of Minnesota Hospital.)

There are other methods employing restraining units of specific design. One method employs an apron type restraint covering the feet, hands, legs and hips. The apron slips over the front of the chair and across the lap, covering the hands and arms, and fastens behind the chair. Here, the hands are not sufficiently secured and the body can easily slide forward. Another method employs a common trunk strap 10 feet in length which is wrapped

Fig. 4.—Arm board for use on surgical and dental chairs in intravenous anesthesia; showing restraint for control of arm made of soft cloth band with tape ties. This has proved to be more efficient and comfortable for control of the arm than a buckle strap or adhesive tape. Slots in the board permit backward or forward positions of the restraining band and arm as required in a lying or sitting position.

Fig. 5.—Arm restrained on board employed in intravenous anesthesia. It is seldom necessary to use the body strap in intravenous anesthesia except in the longer procedures. It affords better body support and suspends the loose arm, preventing its slipping and dangling down alongside the chair.

around the chest, chair and legs. This method embarrasses respiration directly, and it is therefore undesirable. Another method involves the use of a long strap made of sheepskin, which is placed around the knees and over the arms, and fastens behind the chair. This allows undesirable freedom. Another method requires the use of wrist cuffs, one on each side of the chair, to restrain the arms. This method controls the hands, but not the body. There is a possibility of injury to the hands and arms when wrist cuffs are employed on the chair. Then there are the restraining methods and straps shown in the accompanying figures, which have proved to be particularly useful and satisfactory in the general field of anesthesia. These

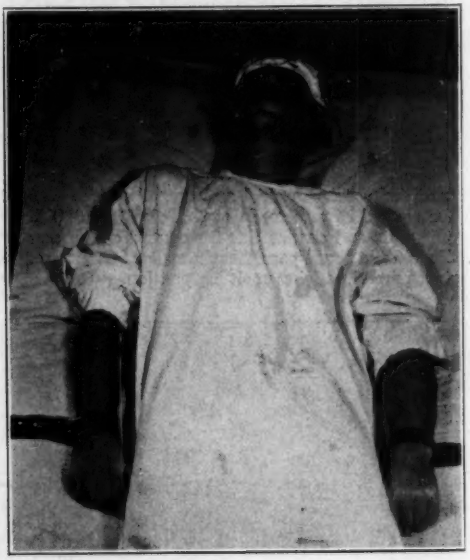

Fig. 6.—Simple but effective method of restraining hands to avoid self-inflicted injury or interference with appliances for patients who may be irrational as a result of injury or under general anesthesia in maxillofacial treatment. The patient lies on a strap to which are attached straps encircling the wrists and locking with snap buttons to restrain the hands. In the case shown, severe multiple compounded fracture of the maxilla, mandible, nose and malar bones, the patient wears a headcap with numerous appliances attached and has just returned from the operating room after repositioning of the malar bones.

units can be applied and removed rapidly, and can be used on children as well as adults.

The common argument based on the psychologic attitude of the patient toward use of restraints just before being anesthetized has been overemphasized in a sense. It is logical to expect that if normal functions are interfered

with or the patient has been alarmed in some way when he is normally awake, there may be created a psychologic uncertainty. When, for example, a strap is placed about the chest and anchored to a chair or table, and tightened slightly, but sufficiently to secure the patient and prevent slipping, the normal respiratory exchange may be inhibited from one-fifth to one-third capacity, and, in a short time, the patient may become strained in a normal chest expansion and become alarmed. Also, unnecessary suggestions from attendants may create an adverse mental attitude. Such practice must be eliminated. Rather, confidence should be created by assurances of the safety, security and welfare of the patient, and he will accept the application of restraints before the anesthetic is begun.

I restrain all patients before beginning anesthesia in major surgery when it is possible, and in all dental surgery. In so doing, some otherwise unwanted interference during the operation may be obviated or better controlled. Such routine practice is definitely advantageous for the anesthetist, the surgeon and the patient.

"Studies in Bone Healing."—Replying to many inquiries regarding the incorporation of chemical salts in a gelatin base for use in initiating bone repair *(J. Oral Surg.,* 1:191, July 1943), Fosdick and Schram write:

"The preparation is composed of: calcium phosphate 95 per cent, calcium carbonate 3 per cent, magnesium carbonate 1 per cent, sodium carbonate 0.5 per cent, calcium fluoride 0.2 per cent, sodium fluoride 0.2 per cent and ferrous sulfate 0.1 per cent, placed in a flask and shaken to obtain an even mixture. As much of this material as possible was incorporated in a 5 to 8 per cent water solution of U.S.P. gelatin. The mixture was made over a steam bath with the temperature of the gelatin solution as high as possible in order to allow the incorporation of the maximum amount of bone salts."

UMI

CONTAGIOUS PAROTITIS (MUMPS) COINCIDENTAL WITH TOOTH EXTRACTION: REPORT OF CASE

A. Sanchez de Bergue, Ciego de Avila, Cuba

History.—A woman, aged 27, white, married, weight 150 pounds, height 5 feet 5 inches, had an impaction of the third molars, which was at times a source of pain. Her mother had had impacted third molars in the lower jaw extracted within the year.

Examination.—An x-ray examination revealed an impacted upper right third molar and impacted lower third molars. The upper left third molar had not formed.

Operation.—The upper right third molar was extracted uneventfully under local anesthesia.

Course.—When the patient came in the next day for a check-up, a perfect blood clot was forming and there was no inflammation, but by morning of the following day, there was a severe inflammation extending to the ear and upper part of the neck, with pain.

Examination revealed that the extraction area had healed perfectly. It was believed that the inflammation was due an acute suppurative process around the lower third molar, but x-ray examination did not reveal any pathosis. Because of the pain and inflammation, sulfathiazole was prescribed, with a warm mouth wash, and application of ice and hot packs alternately to the face.

As the inflammation and pain increased, the family physician was called. He shared my opinion that the inflammation was due to a reaction of the lower third molar.

July 10, five days after extraction of the upper third molar, the young son of the patient became ill with mumps, whereupon the physician realized that the mother was also suffering with that disease. Two days later, she developed mumps on the left side of the face.

On recovery, the patient had both lower third molars extracted.

Should a dentist be criticized for failing to think of mumps in the case of a patient aged 27 after extraction of an impacted upper third molar, with a remaining impacted third molar in the lower jaw on the same side?

Current Literature

COMPARATIVE ANTIBACTERIAL ACTIVITY OF PENICILLIN AND GRAMICIDIN: TISSUE CULTURE STUDIES. Dorothy H. Heilman and W. E. Herrell.

Conclusions: 1. Purified gramicidin and a highly concentrated preparation of penicillin have been found to be of the same order of activity against strains of gram-positive cocci growing in a tissue culture medium. 2. There are well-marked differences in the selective bactericidal activity of these two substances. 3. Penicillin and gramicidin act on bacteria slowly. 4. Although small amounts of gramicidin and penicillin may be only bacteriostatic, there is evidence that both substances may be bactericidal under certain conditions. 5. The presence of neither of these substances enhances or inhibits the bactericidal activity of the other.—*Proc. Staff Meet. Mayo Clin.*, 17:321-327, May 27, 1942.

PREVENTION OF RENAL OBSTRUCTION DURING SULFADIAZINE THERAPY. Charles L. Fox, Jr.; Ole J. Jensen, Jr., and Gilbert H. Mudge.

The maintainance of a consistently alkaline urine proved successful in preventing renal obstruction in two patients treated by massive doses of sulfadiazine for subacute bacterial endocarditis. The urinary pH was kept above 7.5 by large doses of sodium bicarbonate and large amounts of fluids before sulfadiazine administration and more alkali was given if the urinary pH fell below 7.5. As the morning specimen has the lowest pH, it is advisable to administer alkalis at night. This also holds true for sulfadiazine and its acetyl forms, which are also relatively insoluble, but whose solubility is greatly increased in urine of pH 7 to 8. In the case of sulfapyridine, this does not occur until pH 9 or 10 is reached. This is beyond the pH range of urine, which accounts for the failure of alkali therapy to prevent a precipitation of this drug in the kidneys.

The authors state that the usual quantities of alkali given are insufficient. They stress the fact that large amounts of bicarbonate were needed to keep the urine at pH 7.5.

In cases of acute or impending renal blockage, they recommend lavage with concentrated sodium bicarbonate and sodium carbonate solutions, on account of their greater solvent action, rather than warm water or saline, in which sulfadiazine and sulfathiazole are but slightly soluble.—*J.A.M.A.*, 121:1147-1150, April 3, 1943.

GENERAL AND LOCAL ADMINISTRATION OF PENICILLIN. M. E. Florey and H. W. Florey.

The authors report and carefully analyze fifteen cases of serious illness, ten of which were staphylococcal, treated with penicillin by mouth or by intravenous or intramuscular injections. Included in the conditions were facial and orbital cellulitis, cavernous sinus thrombosis, acute osteomyelitis, sulfonamide resistant streptococcal meningitis, pyemia, septicemia and actinomycosis. The

authors believe that generalized staphylococcal infection can be cured by penicillin if a sufficient amount is injected to keep the blood serum fully bacteriostatic. In most acute stages, 15,000 units should be given at three-hour intervals on account of its rapid excretion by the kidneys. Careful serum examination is made at the end of the three-hour period to determine whether the bacteriostatic level is adequate, and the dose is increased if it is not.

In estimating clinical progress, bacteriologic findings, pain symptoms, the appetite and the general condition of the patient are of greater importance than the temperature, which usually comes down by lysis over as long as from fourteen to twenty days. Penicillin should be given for several days after the temperature has become normal. Pus, blood, serum and tissue autolysis do not interfere with the antibacterial action of penicillin, and the number of organisms present has little or no effect on its bacteriostatic capacity. Leukocytes will live and tissue cultures will grow in the presence of concentrations many times greater than that necessary for bacteriostasis.

They consider the problem of using penicillin locally a matter of devising some means of applying a very soluble and diffusible substance so that a bacteriostatic concentration is constantly maintained at every point where there are infecting organisms. The whole infected area must be reached, and local application must be accompanied by suitable surgical measures. Orthodox free drainage is undesirable because the penicillin drains away with the exudate. They consider it best to establish a closed cavity from which exudate may be removed periodically and penicillin instilled to reach the entire infected area.—*Lancet*, 1 :387-397, March 27, 1943.

SORE AND BLEEDING GUMS IN NAVAL PERSONNEL: Vitamin C and Nicotinic Acid Intakes. C. C. Ungley and J. S. F. Horton.

In fifty-one naval patients with sore and bleeding gums often labeled scorbutic, the average daily intake of ascorbutic acid estimated from dietaries ranged from 16 to 80 mg. (average 37 mg.) They were unsaturated, but no more than healthy controls. Clinical evidence of scurvy or subscurvy was absent. Local conditions, infection and calculus were sufficient to account for the gum condition and treatment by ascorbic acid was therapeutically ineffective. Vitamin C deficiency was not the prime cause of the soreness and bleeding of the gums. No relation to nicotinic acid deficiency could be demonstrated. Eighty-five per cent had Vincent's stomatitis.

FATAL TOXIC SULFONAMIDE DRUG REACTIONS. William H. Kelley and M. W. Colgin.

The most dangerous of the toxic reactions to sulfonamide therapy are those affecting the hematopoietic system and the kidneys. Acute hemolytic anemia and agranulocytosis have been the cause of the greatest number of deaths and both have occurred more often with sulfanilamide than with its derivatives. Acute hemolytic anemia usually develops during the first five days of therapy, with headache, fever, malaise and great weakness, discoloration of the urine and jaundice. The blood destruction may become critical in a few days and, in surviving cases, four or five days is required before the signs of hemolysis

have cleared up. Death may occur from shock as in acute blood loss or later from renal failure due to the presence of coagulated hemoglobin casts in the renal tubules.

Agranulocytosis, the most frequently fatal of the toxic reactions, usually appears in the second week of sulfanilamide therapy or later.

A daily check on the blood and urine of patients receiving sulfonamide therapy would prevent most of the fatal toxic reactions. Hemoglobin and red and white cell determinations should be made and all urine samples should be observed for red discoloration. Any sudden decrease in the erythrocyte count or hemoglobin value and hemoglobinuria are urgent indications for discontinuing sulfonamide therapy. During the second week, the white count and differential count should be studied for signs of leukopenia or granulocytopenia.—*J. South Carolina M.A.*, 38:257-264, October 1942.

FURTHER OBSERVATIONS ON THE CLINICAL USE OF PENICILLIN. W. E. Herrell.

The author reports the results obtained in the treatment of ten patients in eight of whom the organism of infection was *Staphylococcus aureus.* In one case, the infective organism appeared to be a non-hemolytic streptococcus. Satisfactory results were obtained in these nine patients. In the tenth case, one of subacute bacterial endocarditis, the blood stream could be temporarily freed of the green-producing streptococcus, but, on withdrawal of the penicillin, infection recurred.

The blood cultures were positive in but four of the cases. The infection in the remaining patients was so severe that invasion of the blood would have undoubtedly occurred had not penicillin therapy been instituted early.

Continuous intravenous administration is recommended for moderately severe and severe infections, using 30,000 to 40,000 Oxford units every twenty-four hours dissolved in a physiologic solution of sodium chloride. Initially, from 100 to 200 cc. of penicillin solution is injected at a fairly rapid rate, after which administration is regulated to from 30 to 40 drops per minute. The solution is made up immediately before use and, as administered in the closed system, there is no evidence of loss of potency.

The value of penicillin in infections is illustrated in the case report of a girl aged 4 who had been ill but four days with a progressively increasing swelling and redness of the left side of the jaw and face. The history was negative except for the father's statement that the child had bitten the inside of her cheek on several occasions shortly before the onset. The temperature had risen to 104° F., with pain and difficulty in swallowing and breathing.

Examination revealed marked edema and fixation of the tongue and necrosis of the alveolar lingual region. The area was promptly drained surgically by means of an external stab wound. Extensive necrosis was present, extending through the floor of the mouth. The day after admission, the child was critically ill, apparently moribund. There was cyanosis with evidence of pneumonia in the right lung. Blood studies revealed 4,500 leukocytes with a differential count of 37 per cent neutrophils, 62 per cent lymphocytes and 1 per cent monocytes, and hemoglobin 60 per cent. Blood cultures showed twenty-five

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colonies of a hemolytic type of *Staphylococcus aureus* per cubic centimeter at the end of twenty-four hours.

From 20,000 to 30,000 Oxford units of penicillin were administered by continuous intravenous drip daily for five days. Thirty-six hours after its administration was started, blood cultures were sterile, and they remained so thereafter. Within ninety-six hours, the patient could take a liquid diet without difficulty and was having but little difficulty in breathing. On the sixth day, the rectal temperature was 100° F. On the ninth day, it became normal. The leukocyte count increased progressively as the patient improved.

This type of infection complicated by septicemia and leukopenia is almost universally fatal. Local treatment by penicillin was used by the author in two cases of chronic ulcer of the lower extremity, one of which was associated with an underlying osteomyelitis. Cultures became negative and clinical improvement occurred. Applications were made for from seven to ten days, 2,100 units being used.—*Proc. Staff Meet. Mayo Clinic,* **18**:65-76, March 10, 1943.

CARBAMIDE SULFONAMIDE MIXTURES: USE IN TREATMENT OF COMPOUND FRACTURES AND TRAUMATIC WOUNDS. Frederic W. Ilfeld.

The use of carbamide sulfonamide mixtures in the therapy of a series of wounds in forty-one patients with compound fractures and other serious traumatic injuries demonstrated that, in fresh contaminated wounds, as a first aid measure, it permitted a long delay before definitive surgical measures. The emergency treatment consists of sprinkling the mixture in powder form over the wound, followed by a dry dressing and an elastic or ace bandage. Fractures are splinted. The author states that the definitive treatment of compound fractures, tendon and other traumatic injuries described is intended for use only in hospitals where sufficient time and material, as well as technical skill are available, and that, under these conditions, the use of carbamide sulfonamide mixture, internal fixation of the fracture and primary closure of the wound will result in primary healing. At operation, in hospital, after the area has been thoroughly cleansed and wiped with ether and tincture of mercresin or merthiolate, the wound is draped with sterile sheets and thoroughly irrigated with 1,000 cc. of normal saline solution followed by 500 cc. of a saturated solution of carbamide sulfonamide mixture in sterile water. After débridement, which is described as a partial excision or saucerization of the wound, irrigation is repeated with first a normal saline solution and then a saturated carbamide sulfonamide mixture solution. Sulfathiazole or sulfanilamide may be given orally for ten days after the operation. The wound is not inspected until the seventh to tenth day unless there is evidence of spreading infection. It is believed that the carbamide sulfonamide preparation is an improvement over any of the sulfonamides used in mixtures or alone. The author states that in addition to the better functional and cosmetic result of primary closure with this treatment, there is at least one-third less disability, with corresponding rapid return to duty and reduction in the number of days in hospital.—*Surg., Gynec. & Obst.,* **76**:427, April 1943.

Book Notices

The editorial board acknowledges with thanks the receipt of the following volumes. A selection of these will be made for review, precedence being given to new books and those having the greatest interest for our readers.

Applied Anatomy of the Head and Neck. Harry H. Shapiro, D.D.S. Assistant Professor of Anatomy, College of Physicians and Surgeons, Columbia University. Cloth. 189 pages with 173 illustrations. Price $6.75. Philadelphia: J. B. Lippincott Company, 1943.

Differential Diagnosis of Mouth Diseases. By the Class of December 1943 and the Oral Diagnosis Staff of the School of Dental and Oral Surgery, Columbia University. Cloth. 410 pages. New York: King's Crown Press Division of Columbia University Press, 1943.

Lectures on War Medicine and Surgery for Dentists. Edited by Edward J. Ryan, Chairman of Institute of War Medicine and Surgery for Dentists, and Ethel H. Davis. Privately Printed, 1943. Chicago. Price $3.00. (Limited number of copies for sale. Requests should be made to Chicago Dental Society, 30 N. Michigan Ave., Chicago, Ill.)

Textbook of Exodontia. Leo Winter, D.D.S., M.D., F.A.C.D., F.A.C.S., Sc.D. (Hon.), LL.D., Professor of Oral Surgery, New York University. Cloth. 576 pages. Fifth Revised Edition. 485 illustrations and seven color plates. Price $10. St. Louis: C. V. Mosby Company, 1943.

Oral Diagnosis. By Kurt H. Thoma, D.M.D., Professor of Oral Surgery and Brackett Professor of Oral Pathology, Harvard University; Oral Surgeon and Chief of Dental Service, Massachusetts General Hospital; Oral Surgeon, Brooks Hospital; Dental Surgeon, Dental Department, Consultant in Oral Surgery, Tumor Department, Boston Dispensary and Joseph H. Pratt Diagnostic Hospital; Consulting Oral Surgeon, New England Baptist Hospital, and Consulting Oral Surgeon, Beth Israel Hospital. Second edition, revised. 495 pages with 666 illustrations, 63 in colors. Philadelphia and London: W. B. Saunders Company, 1943. Price $6.75.

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Announcements

Copies of Journal of Oral Surgery Needed

The supply of the January (No. 1) and April (No. 2) issues of the Journal of Oral Surgery is exhausted. Many libraries of dental societies, schools and hospitals did not subscribe in time and now wish to make their files complete. The Journal would appreciate receiving copies of these issues from subscribers who can spare them. We will pay for them or extend the subscriptions of those returning these issues by one or two issues.

War Section of the Journal of Oral Surgery

A special war section will be included in future issues of the Journal. This will provide opportunity for officers of the services to contribute to the literature of oral surgery and allied subjects. The rôle of the dentist in war enables him to undertake clinical research on numerous surgical problems and to observe and record findings on large numbers of patients. Much valuable information should accumulate that will be of service to dentistry in the field of oral and maxillofacial surgery. The advances in treatment resulting from the extensive experience of World War I should be activated by that gained in the present conflict. The correlation of such a mass of practical information should clarify many of the problems concerning infections and postoperative care, anesthesia and the treatment of injuries of the jaws and face.

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